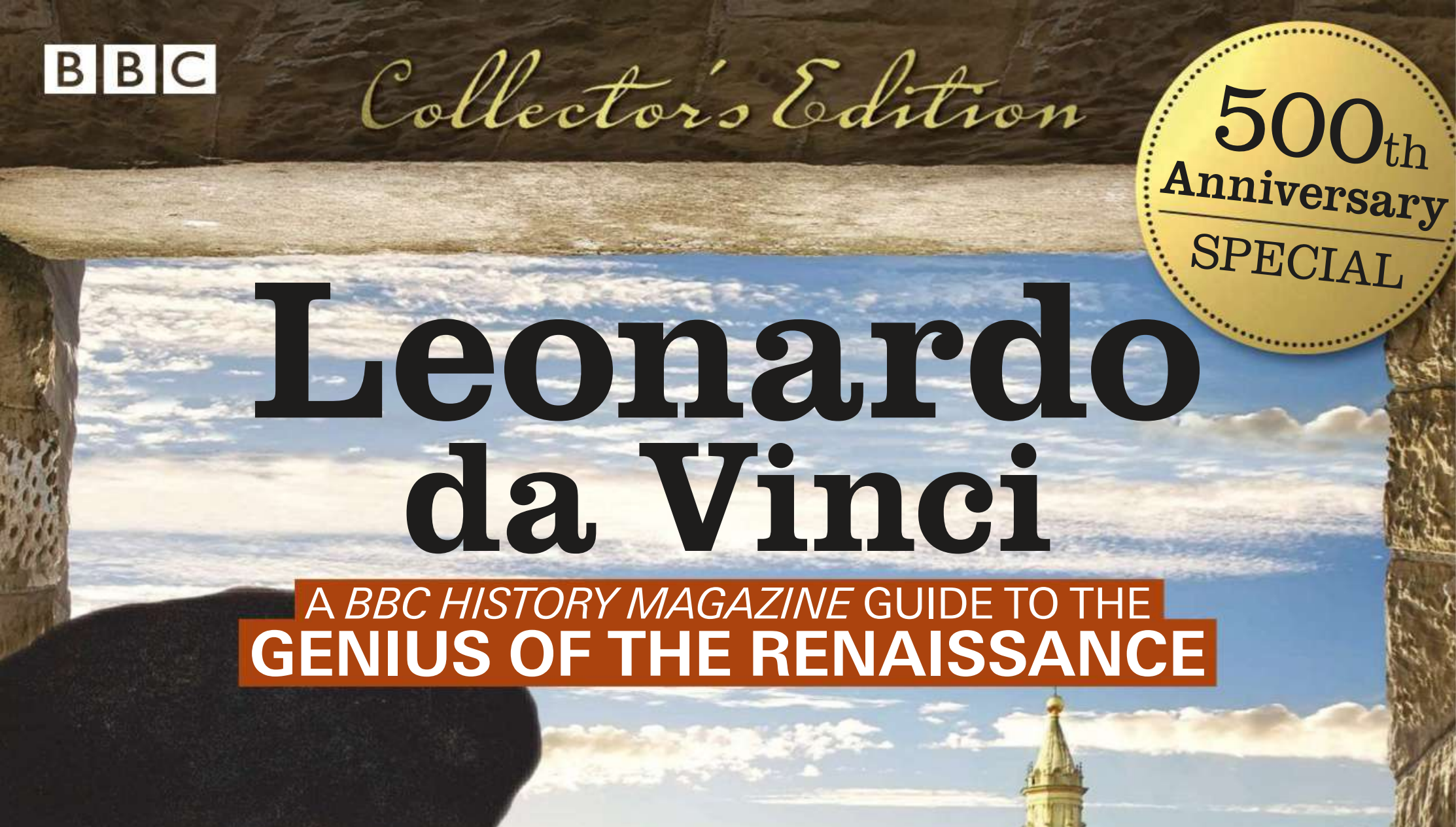
BBC

Collector's Edition

500th Anniversary SPECIAL

Leonardo da Vinci

A *BBC HISTORY MAGAZINE* GUIDE TO THE GENIUS OF THE RENAISSANCE



- From apprentice to artistic visionary
- Inside his rivalry with Michelangelo
- The real story behind the Mona Lisa
- Incredible inventions and discoveries

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WELCOME

ON THE COVER: LEONARDO DA VINCI/FLORENCE CITYSCAPE - GETTY IMAGES
THIS PAGE: STEVE SAYERS-THE SECRET STUDIO

Five centuries after his death, Leonardo da Vinci's legacy lives on in creations such as the *Mona Lisa* and the *Last Supper* – two of the most recognisable works of art in existence. As well as being a talented painter, however, Leonardo was also a skilled scientist and engineer with an incredible range of interests.

For this collector's edition of *BBC History Magazine*, we have worked with some of the world's leading Leonardo experts to bring you the story of the man's life and career, beginning with his **apprenticeship in Florence** in the workshop of Andrea del Verrocchio, right through to his **final years in France** as a respected figure in the court of King Francis I.

Throughout this collector's edition, you'll be able to enjoy a varied selection of Leonardo's **paintings and drawings**, with comments putting them into their creative and historical context. We also examine the **extraordinary notebooks** that he left behind, which allow us to appreciate the extent of his genius.

We explore the background to Leonardo's work – **Renaissance Europe** – and reveal how his professional interests were affected by the politics of Italy's powerful city states. We take a closer look at **the patrons who commissioned the artist** to produce his most iconic creations, and discover his rivalry with the **young Michelangelo**. Besides Leonardo's art, we shine a spotlight on some of his other notable achievements, including his **investigations into anatomy**, his fascinating career as a **military engineer** and his lifelong **obsession with flight**.

I hope you enjoy this collector's edition about the man whose ideas were truly centuries ahead of his time.

Jon Bauckham
Editor

"Leonardo dreamed of the future but was in many ways the perfect embodiment of his own age"

DOMENICO LAURENZA documents Leonardo's attempts at building a working flying machine **on page 92**

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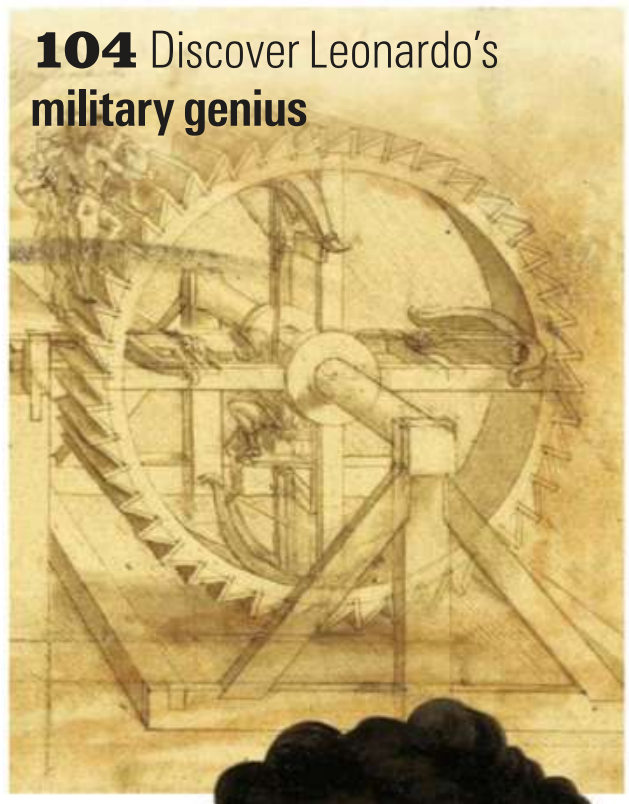

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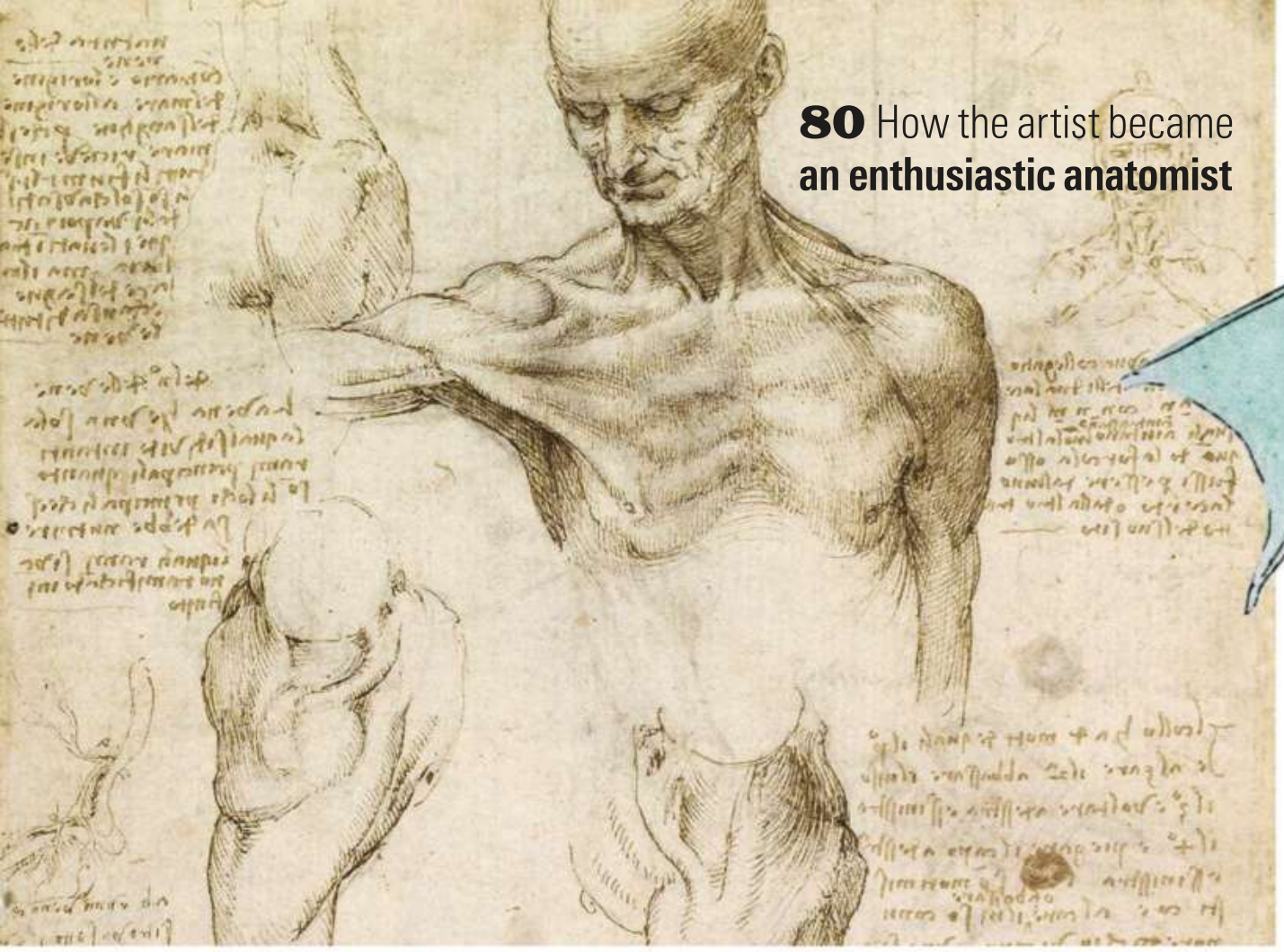

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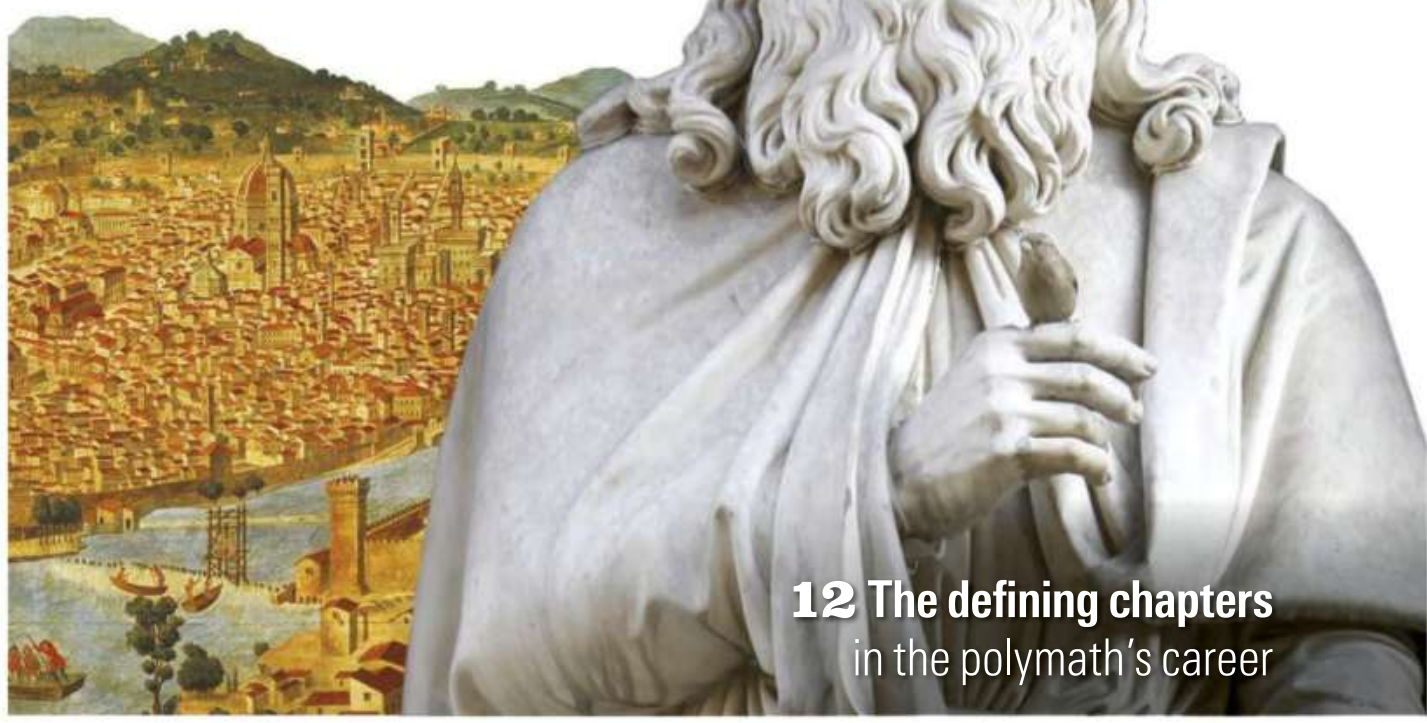

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Timeline

Maya Corry reveals the key dates associated with the life of Leonardo da Vinci, Renaissance Italy's famous artist, visionary and polymath

Leonardo was likely born in his grandparents' house in Vinci, Tuscany

1452
A modest birth

Leonardo is born at about 10.30pm on Saturday 15 April 1452. Despite being illegitimate, his paternal grandfather carefully records the event in a family notebook**.** Leonardo's mother, Caterina, a poor peasant, is only 15 years old. His father, Ser Piero da Vinci (simply meaning 'Ser Piero from Vinci'), is a notary – a lawyer who draws up contracts – **an important profession at a time when most people are illiterate**. Not long after Leonardo's birth, Caterina marries a farmer; Ser Piero's family probably provide her with a dowry, allowing her to gain a degree of respectability.

1476
Accused of sodomy

The 24-year-old Leonardo is **accused of having committed the crime of sodomy** with Jacopo Saltarelli, a 17-year-old goldsmith's apprentice. This is not unusual: during this period, up to half of all the young men in Florence were involved in similar cases. Attitudes to sex and sexuality in this setting were quite different to today. Many older men, including those who were married, had sex with adolescent boys, and despite official condemnation from church and government it was broadly tolerated. **The charges against Leonardo are dismissed due to lack of evidence.**

Drawing of a human skull by Leonardo, c1492

1489
Anatomical inroads

Leonardo is busily occupied with anatomical investigations. **He makes detailed and beautiful studies of the human skull**, and notes on 2 April that he is working on a book entitled *On the Human Figure*.

1480

A 15th-century fresco of Florence, showing the city's octagonal Baptistery in the centre – still a famous sight today

1472
The young artist turns pro

Leonardo is **registered as a member of Florence's painters' confraternity**, the professional association artists had to join in order to work in the city. Now 20 years old, he has completed his training at the workshop of Andrea del Verrocchio.

1481
An early contract

Leonardo receives a **commission to paint the *Adoration of the Magi*** altarpiece for the main altar of an Augustinian convent church. Although evidence suggests that Leonardo has been working on the painting in September 1481, **he never finishes it, for he will soon leave Florence for Milan**.

Detail from Leonardo's *Adoration of the Magi*, which the artist left incomplete

A Leonardo drawing of an elderly man and a youth in profile

1490
The arrival of Salaì

In July, Leonardo takes on a 10-year-old boy named **Gian Giacomo Caprotti, known as Salaì, as an apprentice**. Leonardo is an indulgent master, recording purchases of "rose-coloured hose" and silver cloth with green velvet trim for the boy's clothing. This is despite the fact that Salaì is **extremely naughty and an inveterate thief** who steals from Leonardo and other members of the workshop.

The patron of the arts Isabella d'Este (seen in a painting by Titian) hosted Leonardo in Mantua

1500
Sojourns in Venice and Mantua

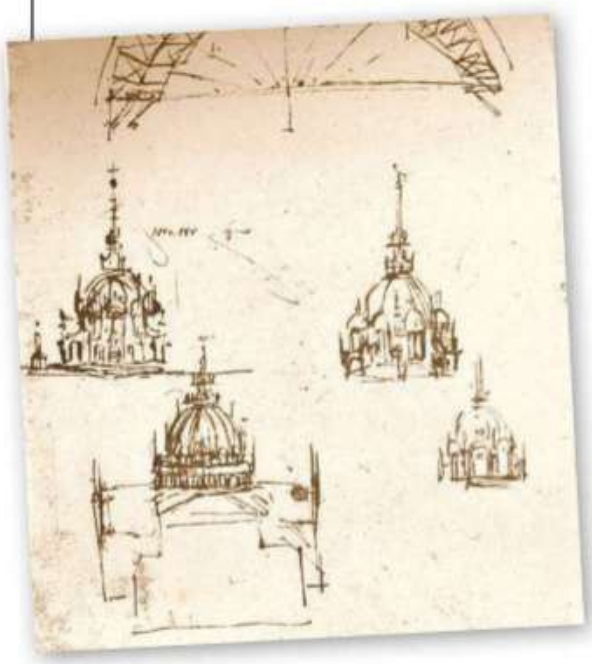
Before returning to Florence, Leonardo is hosted in Mantua by the marchioness and **great patron of the arts, Isabella d'Este**. He also visits Venice, where he is employed by the government to draw up proposals for defences against the threat of a Turkish attack.

1490 | **1500**

1490
A professional setback

On 27 June, Leonardo **loses a competition to design a *tiburio*** (a type of domed tower) for Milan's great cathedral. He has been working on his design for three years, and has even produced a wooden model of it.

Sketches Leonardo produced showing his designs for the tower at Milan Cathedral



1499
The artist flees French forces

The French army invades Milan and Leonardo's employer, **Duke Ludovico Sforza, is captured and imprisoned**. It is reported that the troops "shamefully ruin" the artist's huge (nearly 30ft high) model of an equestrian statue by making it "a target for the Gascon bowmen". **Leonardo leaves the city in a hurry**.

King Louis XII of France rides into Italy to lay claim to Milan and Naples during the Second Italian War (1499–1504)

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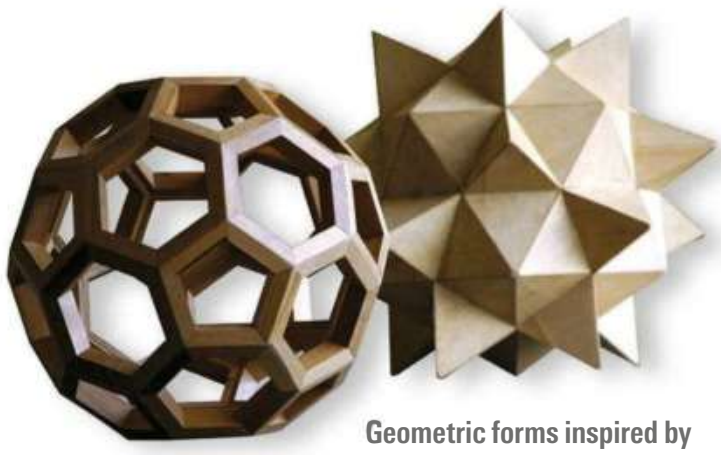


Geometric forms inspired by Leonardo's drawings, on display at the Leonardo Museum in Vinci

1501

Back to Florence – and work

Isabella writes anxiously for news of what Leonardo is up to in Florence. She ardently desires a "devout and sweet" picture of the Madonna, and another portrait drawing of herself for, annoyingly, her husband has given away the one Leonardo made while staying with them. Isabella's agent replies that, although Leonardo is working on a cartoon of the *Virgin and Child with Saint Anne*, and the *Madonna of the Yarnwinder*, he is **"much distracted" by problems of geometry and mathematics** and is doing little painting.

1504

Leonardo's father dies

On 9 July, **Leonardo records the death of his father, Ser Piero**, in his notebook. He subsequently enters into a legal battle with his seven half-brothers over their father's estate, which ends up poisoning his family relationships.

One of Leonardo's notebooks, featuring comments on the death of his father, Ser Piero da Vinci

A sketch from the *Codex on the Flight of Birds*

1505–06

Lofty visions

Leonardo produces a short text, the *Codice sul Volo degli Uccelli* (Codex on the Flight of Birds). In words and drawings, he records his meticulous observations on the **physics and mechanics of avian flight**. This is a long-standing fascination of his, intimately linked to his desire to build a **flying machine** allowing man to ascend to the skies.

Preparatory sketches for Leonardo's 'lost' painting of the battle of Anghiari

1506

A man in demand

Charles II d'Amboise summons Leonardo back to Milan, and requests that the Florentine government **release him from his commitment to complete a painting of the battle of Anghiari**. Although the artist is permitted to depart, local officials grumble that he has "taken a good portion of the money and has made a small beginning of a large work". Legal trouble arising from another unfinished commission, the *Virgin of the Rocks* altarpiece, **hastens Leonardo's return to Milan**.

Portrait of Pope Leo X (centre) with cardinals Giulio de' Medici (left) and Luigi de' Rossi, by Raphael, c1518

1513–16

The patronage of the Medici

Leonardo goes to Rome, where Giuliano de' Medici, the brother of Pope Leo X, **provides him with living quarters and a workshop in the Vatican Palace**. He works on his intended book on painting, the *Libro di Pittura*, and is occupied with mathematics, engineering, architecture and cartography. Making himself useful to the Medici, he builds a diplomatic gift to be presented to the king of France: **an astonishing mechanical lion** that walks, moves its head and opens to reveal fleurs-de-lys (lilies that symbolise France).

1508

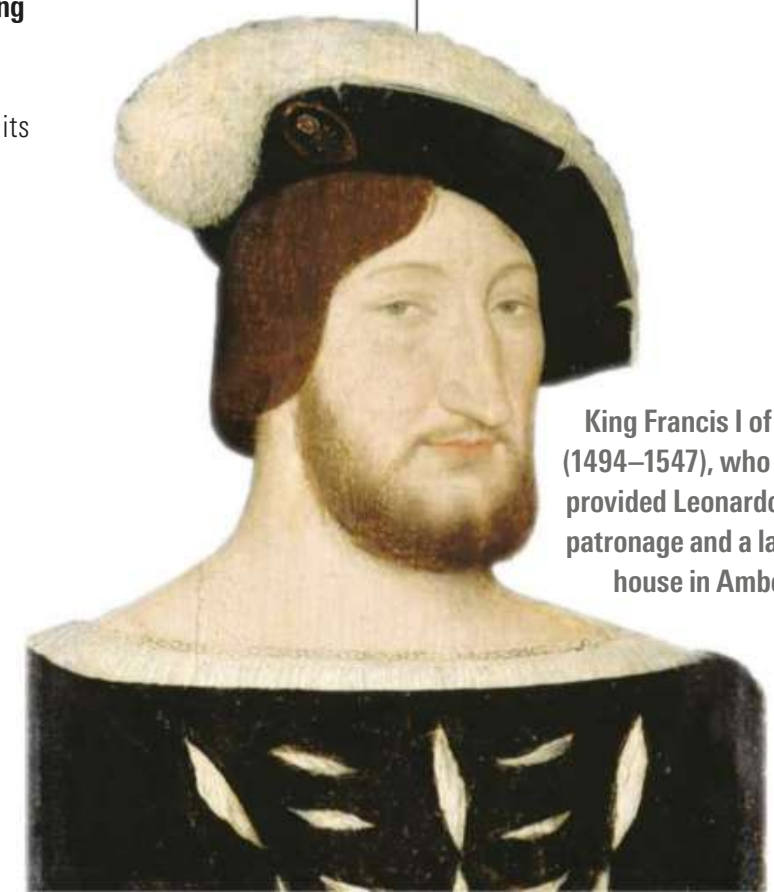
Slicing into nature's secrets

During a brief stay back in Florence, **Leonardo carries out a dissection of 'the centenarian'**: a man who "a few hours before his death, told me that he was over 100 years old". The artist is **fascinated by the ageing process**, and greatly excited by this unique opportunity to examine its workings closely.

1516

Leonardo's last journey

Aged 64, Leonardo departs for France. **He travels at the invitation of the French king, Francis I**, who provides him with a generous stipend and a house near the royal court of Amboise in the Loire Valley. He is accompanied by Salaì and another pupil, Francesco Melzi, who also receive salaries.



King Francis I of France (1494–1547), who provided Leonardo with patronage and a large house in Amboise

The Chapel of Saint Hubert at Amboise Castle, which houses Leonardo's tomb

1519

Loss of a genius

On 2 May, **Leonardo dies, aged 67**. He bequeaths his property, paintings, drawings and manuscripts to Melzi and Salaì, and his money to his half-brothers. According to his wishes, masses are said for his soul, and **he is buried in Amboise**. Melzi writes to his family in Florence describing his "endless sorrow" at the death of a man who had been "like a father" to him. H

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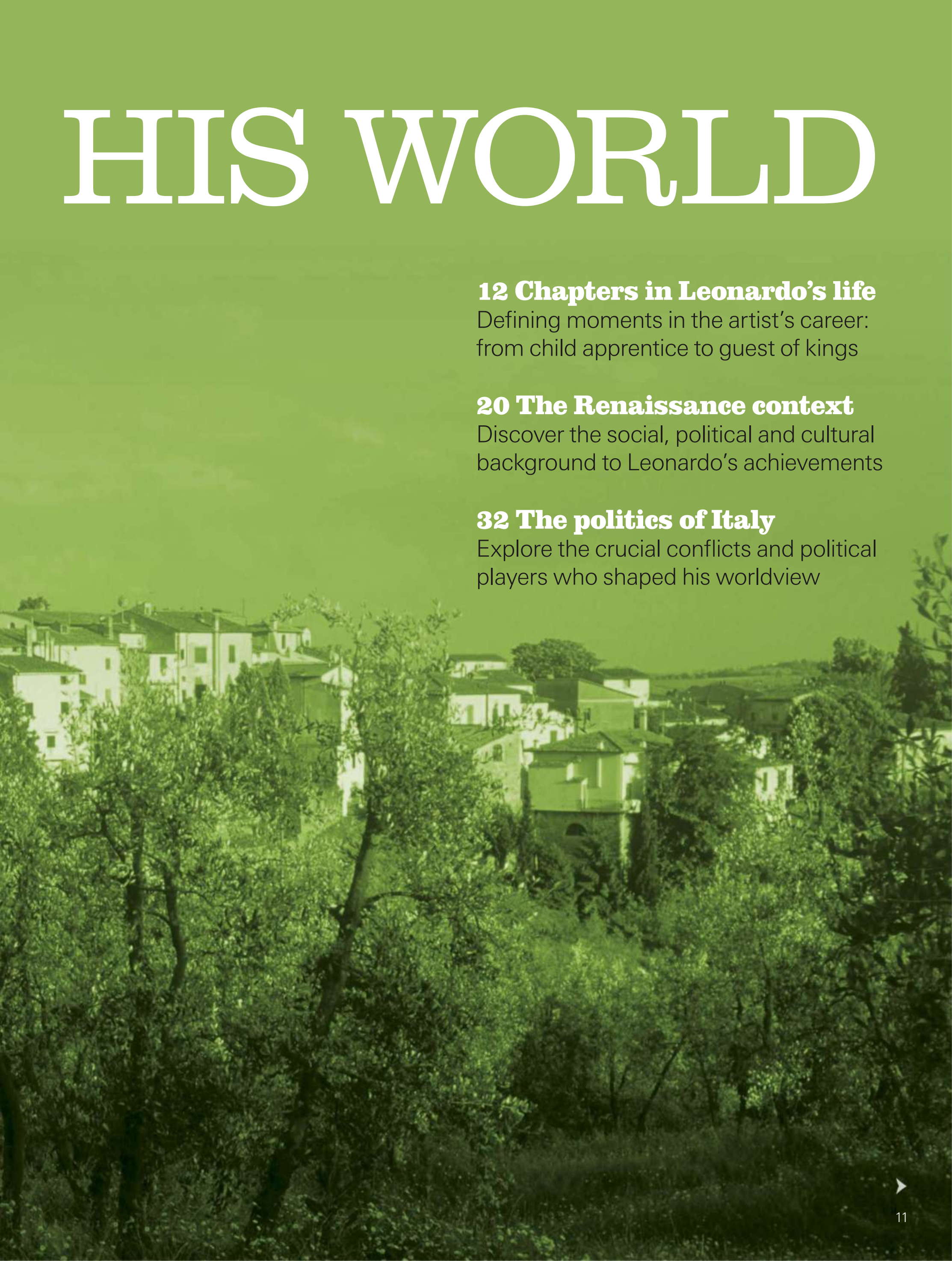
THE MAN &

ROBERT HARDING

A photograph showing the town of Vinci in Tuscany – the source of Leonardo da Vinci's name

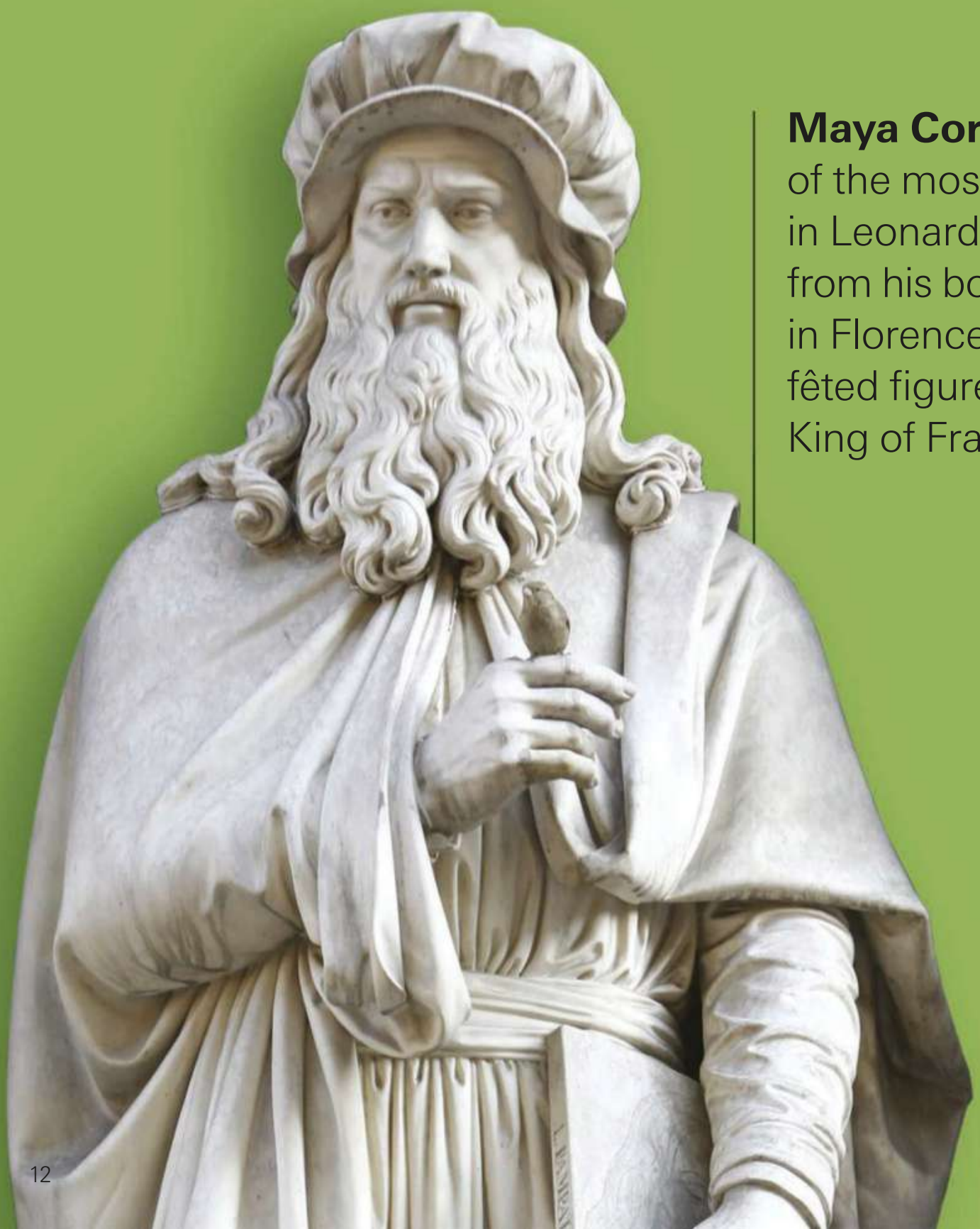
HIS WORLD



Leonardo's rise to success

TURNING POINTS IN A LONG CAREER

Maya Corry explores eight of the most important chapters in Leonardo's professional life – from his boyhood apprenticeship in Florence to his final years as a fêted figure in the court of the King of France



Renaissance man
A bird perches on a statue of the great painter, sculptor, architect, anatomist and engineer outside the world-famous Uffizi Gallery in Florence

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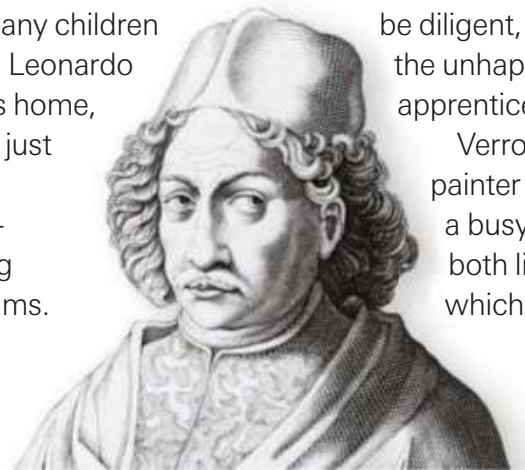
Cradle of learning
A Flemish engraving dating from the 16th century depicting a master and his apprentices carrying out their duties in a busy artist's workshop

LEONARDO... THE APPRENTICE

Leonardo moves to Florence – and an artist's workshop

Around 1464, the young Leonardo went to Florence to live with his father. Although he did not have the full advantages of those born in wedlock, his illegitimacy was not a serious hindrance. While the church stridently condemned sex outside marriage, the realities of life, love and lust meant that many children were the result of such unions. Leonardo was welcomed into his father's home, and Ser Piero provided for him just as he did for his legitimate offspring. The boy would have received a basic education, being taught to read, write and do sums.



At 12 years old, Leonardo reached the age when boys of his status started to learn a profession, but due to his illegitimacy he could not follow his father and become a notary. His artistic talent was perhaps already apparent by this time, for Ser Piero arranged for him to be apprenticed to the Florentine artist Andrea del Verrocchio (pictured below). Apprenticeships lasted around six years and were often formalised with a contract. These listed the responsibilities of the master: to keep the lad fed, housed, clean and well-dressed, and to teach him all the skills necessary to succeed in his line of work. In return, the child promised to be diligent, honest and – in a sign of the unhappiness endured by some apprentices – not to run away.

Verrocchio was a prosperous painter and sculptor. He ran a busy workshop, a space for both living and working, in which he trained apprentices and employed assistants to help him produce the many works of art that his patrons commissioned. Initially, Leonardo would have risen early to light the fire, grind the pigments to make paint, prime panels and prepare all the materials needed for the day's work. In time, he would have graduated to more skilled and important jobs, learning all that he needed to know along the way.

Initially, Leonardo would have risen early to light the fire, grind the pigments, and prepare all the materials necessary for the day's work

A sign of things to come
The Baptism of Christ (1475–78) by Verrocchio and assistants. Leonardo's skilfully painted angel (far left) was said to have made his master jealous

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LEONARDO... THE COLLABORATOR

The apprentice blossoms into artistic maturity

Throughout the next years, Leonardo continued to work closely with Verrocchio, and by 1473 had likely graduated to the position of a paid collaborator. Successful Renaissance artists commonly employed assistants to help them complete large commissions, with several people often working on a single painting. Contracts sometimes specified how much of a picture was to be by the master's own hand – the greater the proportion, the more expensive it was. He tended to be responsible for the most important parts, such as faces and main figures, with patrons happy to leave background details to assistants.

Verrocchio depended on this kind of arrangement to produce his *Baptism of Christ* altarpiece (pictured opposite), on which at least three different artists worked. Giorgio Vasari, the great 16th-century writer on art, claimed that Leonardo contributed the left-hand angel in the painting, and that its great beauty prompted fierce jealousy in Verrocchio. Although Vasari wrote decades after the events and we have to take his words with a pinch of salt, many art historians nevertheless agree that the angel – and some parts of the landscape – were painted by the young artist.

By this point, Leonardo was also producing works of art that were entirely his own efforts, such as the *Annunciation* (see page 30). This picture might have been his 'masterpiece': the work that proved he had mastered his profession and was eligible to join the painters' guild. It shows the young Madonna interrupted in her reading by the arrival of Gabriel, winged like a bird of prey, who tells her she will give birth to the son of God. They appear in a beautiful garden, the ground strewn with flowers. In the background the vista fades away into misty mountains. Both the Virgin and angel are delicate beauties, in the same vein as the *Baptism of Christ*'s left-hand angel. In these early paintings, we can see themes that were to preoccupy Leonardo throughout his career: the workings of light and vision; emotional interaction between figures; the careful observation of the natural world; and the depiction of ideal beauty.

Already we see his preoccupation with light and vision, emotional interaction, the natural world and ideal beauty

Man of many talents
A 19th-century relief at Piazza della Scala, Milan, showing Leonardo presenting his new navigation system for the Navigli canal to Ludovico

LEONARDO... THE SALESMAN

Leonardo proves his worth to the Duke of Milan

Around 1482, Leonardo left Tuscany and journeyed north to Milan, seeking the patronage of the city's ruler, Ludovico Sforza. For ambitious artists, writers, scholars and musicians, there was nothing better than an official position at the court of a great lord or lady. It came with a salary, providing freedom from the usual pressure to hustle for commissions and stick to agreed deadlines.

This was clearly an attractive prospect for Leonardo, and he presented himself to Ludovico with a hard sell. With a canny awareness of what would most appeal to the duke, he laid out his skills in a letter. First and foremost, he declared, he was a master of "instruments of war", who could build ingenious weapons for Ludovico that would "cause terror to the enemy" (this was a time of almost constant conflict). Most of the letter is taken up with descriptions of these "secret" military inventions, but Leonardo also mentions the bronze equestrian monument Ludovico wished to erect in honour of his late father, Francesco, boasting that he would be able to make this "to the immortal glory and eternal honour… of the illustrious house of Sforza".

Leonardo concluded by listing his other talents: in architecture, hydraulics, sculpture and, finally, painting. During the Renaissance, it was common for painters to have several strings to their bow. Many were also skilled in other fields, such as sculpture, metalwork, manuscript illumination or engineering. Some read classical texts and published learned treatises on these topics. Leonardo was not entirely unusual then, but the range of areas in which he claimed to be a master was broad, making him an attractive prospect to a ruler such as Ludovico.

Although the duke was rich he was not profligate and Leonardo did not secure the salary he coveted until 1489. In the meantime, he took on commissions such as the *Virgin of the Rock*s altarpiece (see page 48). This shows the apocryphal meeting of the little cousins Christ and John the Baptist in a mysterious rocky landscape, watched over by the Virgin and an angel. The carefully arranged composition is suffused with a gentle light and sense of calm majesty, the figures united by gestures and gazes. The painting showcases his talents and was swiftly celebrated.

LEONARDO... THE COURT PAINTER

Intimate court paintings break new ground

In July 1493, Leonardo noted that a woman named 'Caterina' had joined his household in Milan. This could have been a housekeeper, but it may be that after many years, he was finally reunited with his mother. This would have presumably brought additional happiness at a time of general prosperity and success for the artist, who had been given quarters in the Corte Vecchia, an old ducal palace. There he had a large workshop space, allowing him to build a huge model of the monument to Ludovico's father. Included among the members of his workshop were young Milanese artists such as Giovanni Antonio Boltraffio and Marco d'Oggiono, as well as apprentices including Gian Giacomo Caprotti da Oreno, better known as Salaì. Under Leonardo's influence, they produced numerous drawings and paintings of exquisite young men and women.

Leonardo was fascinated by physical loveliness, but the activities of the workshop were also shaped by the tastes of the courtly circle that surrounded Ludovico. This included nobles, scholars, poets, musicians and physicians, many of whom were also interested in ideal beauty, and what it communicated about those who possessed it. Leonardo and Boltraffio (who was of noble blood) were welcomed into this world. Pleasurable time was passed debating the key intellectual questions of the day, and Leonardo was praised for his knowledge and verbal skill. During this period, he produced a number of portraits of members of the court: a musician who was probably his friend Atalante Migliorotti (*Portrait of a Musician*); the educated and erudite Cecilia Gallerani, Ludovico's teenage mistress (*Lady with an Ermine*, see page 103); and a self-possessed, dark-haired woman, possibly Lucrezia Crivelli (*La Belle Ferronnière*, pictured below).

In these paintings, Leonardo employed traditional methods of identifying a sitter – the musician, for example, holds a sheet of music – and potent symbolism. The ermine caressed by Cecilia represents both chastity and lust, and is a play on her name (the Greek word for 'weasel' is similar to Gallerani). But he also sought psychological realism, rejecting the more traditional profile format in favour of dynamic poses that highlight the life and movement of each sitter, and make viewing feel like a truly interactive experience. Contemporaries spoke with admiration of Leonardo's ability to encapsulate an individual's inner world in a single image. The court poet Bernardino Bellincioni wrote that the painted Cecilia "appears to be listening", and that she would remain "alive and beautiful" for all eternity thanks to Leonardo's skill.

Contemporaries spoke with admiration of Leonardo's ability to encapsulate an individual's inner world in a single image

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LEONARDO... THE MASTER

A religious masterpiece is born

Relatively early in the 1490s, Leonardo received another major commission. He was asked to paint a mural of the Last Supper in the refectory of the Dominican monastery of Santa Maria delle Grazie in Milan, where the ducal family often worshipped. The task of depicting Christ's final meal with his disciples, when he revealed to them foreknowledge of his terrible betrayal and death, must have been exciting for Leonardo. It allowed him to explore visually his beliefs about how the body communicates inner states of being.

Fascination with this question drove both his artistic and scientific investigations, for it is impossible to clearly divide one

Capturing emotional states
Detail from *The Last Supper* (see page 66 for the full painting) showing the reaction of Christ's disciples as he predicts his betrayal and death. Judas is shown clutching his bag of money

from the other. Leonardo's notes are full of assertions that the painter ought to be constantly aware of how the "motions of the mind" are visible in bodily movements, gestures and facial expressions. He even recorded the faces of passers-by that struck him as particularly interesting and animated. As ever, he wanted to comprehend the underlying mechanisms of these processes, and his skull studies also reveal a probing effort to understand how the intellect, or soul, is linked to the body's physical apparatus.

The Last Supper gave Leonardo the opportunity to put his theories on display. Astonished and devastated by Christ's announcement that one of them would cause his death, the disciples convey their feelings with fierce clarity through their body language. The Apostle James flings his arms out in shock, his face registering horror. John the Evangelist turns away from Jesus in pain, as St Peter grabs his knife and gestures in disbelief. Judas's pose reveals his guilt: unlike the others, he does not gesture wildly or in sorrow, but simply turns to Christ in surprise and clutches to himself a bag of coins, the payment for his betrayal. Jesus is the calm centre of the composition (seen in full on page 66), and our eyes are led inexorably to him by the spatial arrangement of the picture and its vanishing point.

While the subject of the picture was much to Leonardo's liking, its size posed a challenge. He preferred to work slowly and delicately, but fresco painting had to be done quickly. To solve this problem, he developed a new method of applying the pigment, allowing him to move at his preferred pace. Over the years the duke became impatient with the slow progress of the painting, and Leonardo had to mollify him with promises that he was getting on with it. Ultimately, Ludovico was much pleased with the work, and he rewarded Leonardo with the gift of a vineyard near Porta Vercellina. The picture's fame spread, although Leonardo's experiments with the new way of applying the pigment soon caused it to begin to deteriorate.

Draughtsman
A study for the mural of the *Battle of Anghiari*

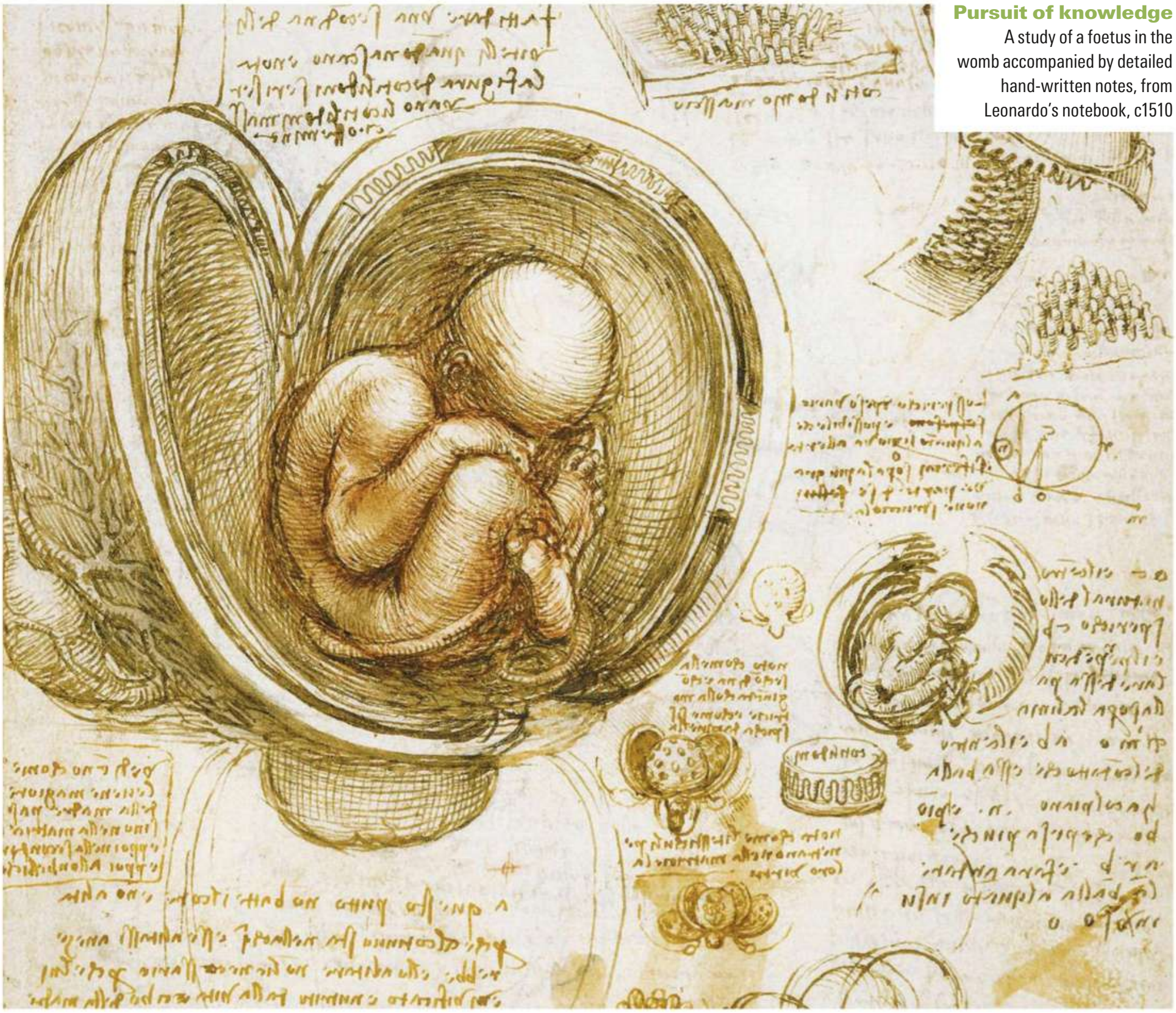
LEONARDO... THE POLYMATH

From military architecture to the Mona Lisa

Having spent the previous year working as a military architect and engineer for Cesare Borgia, captain of the papal armies, in 1503 Leonardo sought a new patron. He wrote to the Ottoman Sultan Bayezid II describing his prowess in hydraulics and engineering, and offering to build bridges: one "as high as a building, and even tall ships will be able to sail under it"; another "across the Bosporus to allow people to travel between Europe and Asia". Nothing came of this overture and Leonardo, who was now 51, must have been frustrated by the loss of security and, above all, freedom that he had experienced since leaving Milan. He had to return to the world of the jobbing artist, bound by the terms of contracts, with his time spoken for.

Leonardo came to be employed by the Florentine republic to manage the diversion of the river Arno, and was commissioned to produce an enormous mural of the battle of Anghiari in the city's Great Council Hall. The painting, in the seat of power where government was conducted, was to celebrate Florentine military prowess, and was intended to match another mural, of the battle of Cascina, by Michelangelo. The plan thus pitted the two great Tuscan artists against one another in direct competition. Leonardo's surviving drawings for his mural reveal tangles of men and horses caught in the heat of battle. Faces contort with tension, rage and valour; as with *The Last Supper*, he wanted viewers to be immersed in the emotion of the scene. There is another similarity with *The Last Supper*: once more, Leonardo experimented with painting techniques, and once more he was not successful. The colours of the mural ran together, and parts were obscured.

In the same year Leonardo began work on a portrait of Lisa Gherardini, the wife of the merchant Francesco del Giocondo. He could not have known that this little painting, with its clever play on Lisa's name – her smile indicating that she was *giocondo* (jocund) – would become the most famous work of art ever created.



Pursuit of knowledge
A study of a foetus in the womb accompanied by detailed hand-written notes, from Leonardo's notebook, c1510

ALAMY/BRIDGEMAN

LEONARDO... THE ANATOMIST

Leonardo deepens his anatomical investigations

By 1510, Leonardo was settled in Milan and in receipt of a salary from the French king Louis XII, allowing him to focus his attentions on his own interests rather than a major commission. Probably working alongside Marcantonio della Torre, a professor of anatomy from the nearby University of Pavia, he had ready access to bodies for dissection. He started compiling a treatise on anatomy, beginning with the study of "a perfect man" and then discussing the bodies of an old man, an infant and a woman, taking in the development of the foetus in the womb. Leonardo also produced a series of drawings of the skeleton and musculature that remain breathtaking in their detail, clarity and beauty. They not only demonstrate his desire to reveal the body's secrets, but also an extraordinary level of artistic innovation.

Partly thanks to his experience in architecture and engineering, Leonardo developed new methods of depicting the complexity of bodily systems and structures in two dimensions that communicate clearly with no loss of information. These included exploded and layered views, and sequential drawings in series. His anatomical work in this period was driven by empirical observation, but in his notes, we find references to the infinite wisdom of the twin creators, nature and God ("il maestro"), thanks to whom the internal workings of the body are organised so perfectly.

In these years the artist was accompanied by Francesco Melzi, a young Milanese nobleman who became a sort of adopted son to him (formal or informal adoptions were common in the Renaissance, often utilised by those who did not have a natural heir). When, in December 1511, warfare once again forced Leonardo to leave Milan, Melzi hosted him in his family's villa at Vaprio d'Adda, Lombardy.

While staying in the Melzi villa, Leonardo reverted to his interest in the dissection of animals – a mainstay of anatomical investigation at a time when it was not always easy to access human bodies. His fervent desire to comprehend the workings of the heart are revealed in the copious notes and drawings he made of the heart of oxen, wherein he carefully observed the passage of blood through the valves.

Leonardo developed new methods of depicting the complexity of bodily systems in two dimensions

Gathering a lifetime's meditations

Self-reflection
Portrait of a Man in Red Chalk, c1516. Leonardo died just a few years later in 1519, aged 67

In 1516 Leonardo went to live in France, at the invitation of the new king Francis I. In 1517, he received a visit from Cardinal Luigi d'Aragona. The cardinal's secretary recorded that, on a previous occasion, he had visited *The Last Supper* in Milan, which was "most excellent" but "beginning to deteriorate". Now he encountered Leonardo, himself "an old man", who showed them three paintings: a "Florentine woman done from life" (likely the *Mona Lisa*), *Saint John the Baptist* and a Virgin and Child with Saint Anne. All three were "most perfect". It was unusual for an artist to keep paintings with him for such lengthy periods and not part with them, but the fact that Leonardo did so indicates the pictures' importance to him. It was also convenient to have them ready to display to important guests of the king. Leonardo's fame was well established by this point, and it would have been politically useful for Francis I to be able to bask in the reflected glory of being his patron.

Unfortunately Leonardo was no longer capable of painting owing to his age and infirmity. He still did some teaching, but mainly spent his working days organising his voluminous notes for publication. The cardinal's secretary recalled being shown writings on machines and hydraulics and many anatomical drawings by Leonardo, who told them he had performed 30 dissections over his lifetime.

In peace and security, the artist concluded his final years, marshalling a lifetime's work of meditation on the mysteries of life: the forces of nature; God's movement in the universe; and the perfection of the human body and soul. His fascination with these weighty themes drove his activities in painting, sculpture, anatomy, natural science, architecture, optics and hydraulics.

Although today we consider the realms of art and science to be separate, this is not something that Leonardo and his Renaissance contemporaries would have acknowledged. Rather than seeking to compartmentalise his many spheres of activity, we come closer to Leonardo when we recognise the underlying interests that motivated and fuelled them all. H

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EUROPE REBORN

From the 1300s onwards, a new movement in art, culture and thinking took hold across Europe, with Italy at the vanguard. **Catherine Fletcher** looks at how the social, political and religious climate of the time fused with a new-found interest in classical antiquity to give birth to the Renaissance

Hail Caesar
Renaissance art celebrated classical civilisation: Mantegna's *Triumphs of Caesar* series (painted in the late 1400s) lent the glory of ancient Rome to the Duke of Mantua's palace

Leonardo was born into a time and place of intense and exciting artistic endeavour, when some of the greatest artworks of the western world – in painting, sculpture, architecture, music, and literature – were created. It's a period of European history that we know as the Renaissance, spanning the period from 1300 to 1600.

From the French word for 'rebirth', it points to the idea of a revival of ancient art and culture somehow lost in an intervening so-called Dark Age. Nowadays historians point more often to continuities, and prefer to think of the Renaissance as an intellectual and artistic movement (primarily an elite one) rather than a time-span.

In the 16th century, however, the idea of the Renaissance was summed up by Italian painter and writer Giorgio Vasari (1511–74), considered the founder of modern western art history, in his biography of the life of the artist Giotto (c1267–1337). In his book, *Lives of the Most Excellent Painters, Sculptors and Architects*, Vasari wrote that "when the methods and outlines of good painting had been buried for so many years by the ruins of war, [Giotto] alone, although born among inept artists, revived through God's grace what had fallen into an evil state and brought it back to such a form that it could be called good".

In Vasari's account, the fall of ancient Rome had let painting and sculpture go to ruin, while in their zeal to rid the city of its pagan religion the Christians inadvertently destroyed techniques central to the arts. His narrative skips over the art of Byzantium and the great Gothic cathedrals of northern Italy and Europe, perhaps because his real interest was in telling a story about the greatness of his own friends and times. In fact, many ancient manuscripts had been preserved in monasteries and there had been renaissances before: a 'Carolingian' one under Emperor Charlemagne (AD 742–814) and a 12th-century one that played an important role in bringing knowledge from the Arab world to Europe, in part a by-product of the crusades.

BRIDGEMAN

Wisdom of the ancients
One of Vasari's own paintings celebrates Renaissance poets, notably Petrarch (in white), who rediscovered classical scholars

Buying favour with God

The Italian Renaissance benefited from economic developments on the Italian peninsula (which at the time was divided into multiple city states), and in particular from the growing disposable income of a wealthy class of merchants. In parallel, there was a Northern Renaissance, centred on Burgundy and the courts of the Low Countries (the Netherlands and Belgium), which had its own distinct artistic style. The Italian phenomenon, however, was particularly influenced by the geographical proximity of Roman art and architecture, not to mention a long tradition of Roman law. It is no coincidence that Italy was one of the wealthiest areas of Europe. There was money to spend, particularly on art, and motivation to spend it, especially from a religious point of view.

The patronage of Christian art was seen as the sort of good work that might help a person achieve salvation. Usury – lending money at interest – was, at the time, perceived as a sin, but banking was a source of profit for many merchant families, among them the Medici of Florence. Endowing chapels was a way both to honour relatives and to absolve themselves of sin, as well as a means for a newly-rich man to establish a cultural reputation.

As well as Florence, the small court centres of Mantua, Ferrara and Urbino were just as much motors of the artistic Renaissance. Andrea Mantegna (c1431–1506) created spectacular paintings for the Camera degli Sposi (bridal chamber) in the Ducal Palace, Mantua. His *Triumphs of Caesar* series of paintings, also for the Marquis of Mantua, are now at Hampton Court (Charles I snapped up works from the Mantuan collection when it was sold off in the 17th century). These princes were able to finance this art in part because, across Italy, the smaller court societies provided services (especially military ones) to the larger states. Competition and one-upmanship between different courts was also a factor.

Renaissance thinkers looked to their Greek and Roman predecessors for answers on all sorts of subjects

Alongside visual art, the Italian Renaissance had an important literary component. The poet Petrarch (1304–74), who had spent his early life away from Italy, developed a passion for his homeland's culture, especially its literature. Through a network of correspondents, he promoted this interest in ancient texts. There followed a fashion for book collecting, and the 15th century saw the creation of major new libraries, including by the prominent Medici family in Florence, and at the Vatican in Rome.

Printing allowed for the wider circulation of ancient works such as Vitruvius's treatise on architecture, *De Architectura*, which inspired the influential 15th-century Florentine thinker Leon Battista Alberti (1404–72). Renaissance thinkers looked to their Greek and Roman predecessors for answers on all sorts of subjects (which made for a challenge once it became clear that

The sky's the limit
Mantegna's ceiling painting at the Ducal Palace in Mantua uses perspective to imitate classical architecture. It was commissioned to impress the duke's visitors and give his rule cultural credibility

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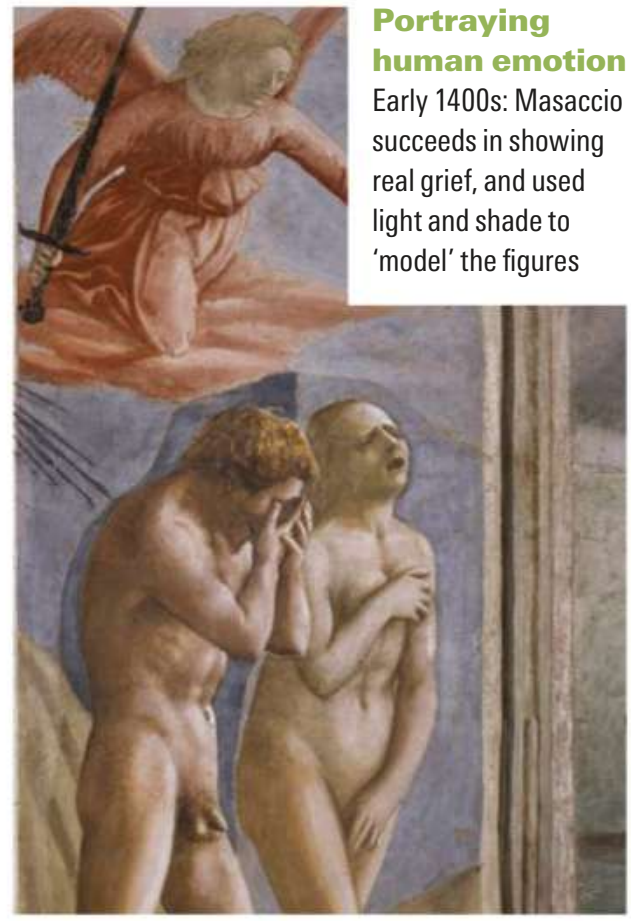
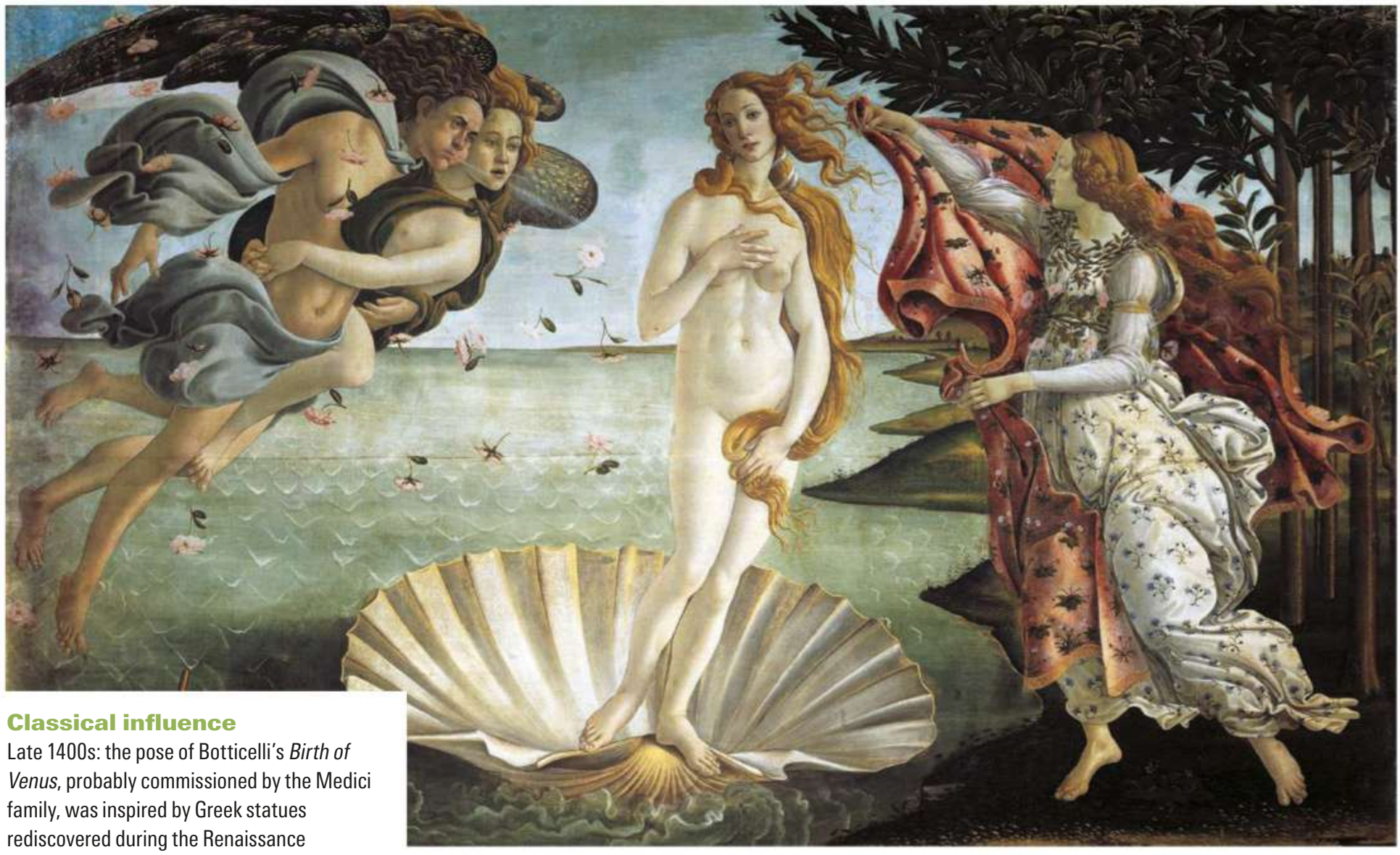
Observed from nature
1300s: Giotto, as in this *Adoration of the Magi,* was one of the first to paint lifelike individuals in credible 3D space



Portraying human emotion
Early 1400s: Masaccio succeeds in showing real grief, and used light and shade to 'model' the figures



Classical influence
Late 1400s: the pose of Botticelli's *Birth of Venus,* probably commissioned by the Medici family, was inspired by Greek statues rediscovered during the Renaissance

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there were more than the three continents that the ancients had discussed).

Interest in the classics also made its way into the world of visual art. 'Grotesque' features of Renaissance art were inspired by the remains of what we now know is the Emperor Nero's Golden House, the Domus Aurea, on the Esquiline Hill, Rome. Artists in the late 15th century believed that the barrel-vaulted palace ceilings they found were decorated grottoes: hence the description *grottesca*.

Other elements of art, however, were new. Giotto, for example, was valued for lifelike figures, observation from nature and ability to convey emotion, not to mention early examples of foreshortening to create perspective. Vasari related how, as an apprentice, Giotto had painted a fly onto the nose of one of his tutor Cimabue's figures, which the master had tried to flick away before realising it was only paint. In the 15th century, the artist Masaccio (1401–28) developed perspective further, most notably at the Brancacci Chapel, Florence, where he portrayed the expulsion of Adam and Eve from the garden of Eden with unprecedented emotional depth, using light and shadow to bring the figures to life.

Return to the classics

Later in the 15th century, major classical subjects became common, with works such as the *Birth of Venus* by Botticelli (1445–1510). Into the 16th century, the 'High Renaissance' artists such as Leonardo

Bringing classical stories to life
Paintings of Greek myths enabled elite patrons to show off their status and learning. Titian's 1520 *Bacchus and Ariadne*, for the Duke of Ferrara, displays typically Venetian bright colours

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(1452–1519), Michelangelo (1475–1564) and Raphael (1483–1520) continued to pioneer new methods to achieve a naturalistic appearance for their artworks, including a detailed study of anatomy. Leonardo was particularly known for his application of scientific study to art; his explorations of light and fluid mechanics inform his painting.

In parallel to these artists (who worked primarily on the Florence-Rome axis), a Venetian school of painting grew up. This placed a stronger emphasis on colour, rather than on line and design. The most famous exponent was Titian (1488–1576), who built on the earlier work of Giorgione and Bellini as well as Andrea Mantegna. We know the names of these artists, moreover, because this period saw an emphasis on the painter as an individual. While some earlier artists are known to us only as 'the Master of the Straus Madonna', for example, Renaissance patrons sought out works from particular star names. Printing, and in particular the work of Vasari in the mid-16th century,

The Venetian school of painting placed a stronger emphasis on colour, rather than on line and design

The glory of God... and Rome
Pinturicchio's Vatican frescoes blend Christian and pagan subjects, typical of the Renaissance. St Catherine (blue dress) is seen before a Roman arch, topped with the pope's own heraldic bull

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helped to create a 'canon' in which certain artists' reputations were crystallised and others excluded or dismissed.

Vasari was not an admirer of Pinturicchio (the nickname of Bernardino di Betto, 1454–1513), but the Vatican apartments that the latter designed at the end of the 15th century for Pope Alexander VI (Rodrigo Borgia, 1431–1503) are a good example of the ways that the art of these years brought together Christian and pagan subjects.

In the apartments, The Arch of Constantine, an ancient monument in Rome, appears in a fresco (pictured opposite) behind an image of the Christian saint Catherine. The Colosseum sits alongside the martyrdom of Saint Sebastian, while the decor for the Room of the Mysteries of Faith features Borgia family heraldic devices, including gilded bulls, the double crown of Aragon and a half-dozen fluttering flames on an ultramarine ground, highlighting the importance of the patron in artistic commissioning. The rooms tell a story of salvation, beginning with the prophecies of the sibyls (female oracles from classical myth) and the prophets (from the Old Testament). Along the way to its final scene of Christ's redemption, the sequence features signs of the zodiac and planets, a reminder of Renaissance interest in astrology.

Combinations of Christian and pagan symbolism were by no means new. The pulpit at Pisa Cathedral, sculpted by Pisano early in the 14th century, included figures representing sibyls and the liberal arts, as well as the more usual Christian figures. In Perugia, at the end of the 15th century, the Collegio del Cambio (guild of moneychangers) commissioned a beautiful fresco series from local artist Pietro Vannucci (1446–1523), known, after the city, as Perugino or 'the man from Perugia'. It included images of both prophets and sibyls, painted to a design by the humanist Francesco Maturanzio (1443–1518), who had taught at the universities of Vicenza and Venice before returning to a role in the Perugian civil service. The sequence includes a ceiling fresco featuring the moon, Mercury, Mars, Saturn, Jupiter and Venus; the theme is man's perfection on earth achieved by accord between ancient virtues and Christian revelation.

A critical approach

Maturanzio brings us to another important development of the Renaissance: humanism. This did not have the connotations of atheism that humanism does today, but was a critical method for the study of texts that was defined in opposition to the older approach known as 'scholasticism'. An important product of this new approach was the overturning of The Donation of Constantine. This document, on the basis of which the popes claimed their authority, was supposed to be a decree by Constantine, the first Christian emperor of ancient Rome in the fourth century AD. However, it had long been rumoured it was a later forgery, and in the 15th century three humanists, all working separately (the German Nicholas of Cusa, the Neapolitan Lorenzo Valla and the English Reginald Pecocke) managed to prove just that. This was important, because it undermined the authority of the papacy and Catholic Church.

Humanism also had a political variant, known as 'civic humanism'. Particularly influential in Florence, this stressed not only the importance of study of the classics and liberal arts but also the practical application of such study in political life.

Many advocates of church reform in the 15th and 16th centuries were humanists. Among them was Erasmus of Rotterdam (1466–1536). When he went back to the texts to translate the Greek of the New Testament into Latin, he argued that the Greek implied that sinners should 'repent' rather than 'do penance', representing a more internalised idea of sin than the traditional emphasis on outward 'good works' in Catholicism.

Although there is no direct relationship between humanism and Martin Luther (1483–1546), many subsequent Protestant reformers had been given a humanist education. Arguably as important to the reform process was the growth of moveable-type printing. Used in Europe from the mid-15th century, it helped spread both humanist and Protestant ideas.

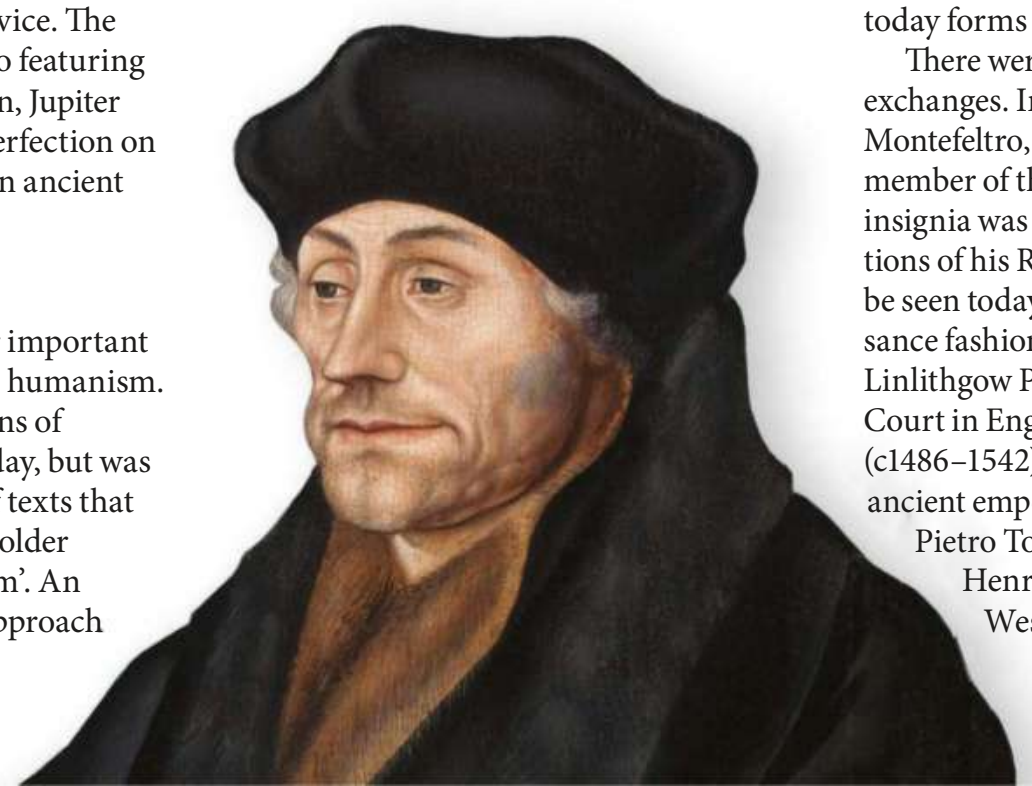
Ancient virtues

TOP Mars from a series celebrating ancient virtues as well as Christian revelation in Perugia

ABOVE Renaissance fashions imported from Italy inspired Tudor England, as shown in this relief roundel of Nero at Hampton Court

BELOW After going back to study the original Greek texts, church reformer Erasmus reinterpreted the Christian concept of sin

Erasmus argued that the Greek implied that sinners should 'repent' rather than 'do penance'



English Renaissance

One of the first Englishmen to be influenced by humanism was Humphrey, Duke of Gloucester (1390–1447). He corresponded with leading lights of the Florentine Renaissance including the city's chancellor, Leonardo Bruni (1370–1444), and his library today forms part of the Bodleian in Oxford.

There were many other Anglo-Italian exchanges. In 1474, for example, Federico da Montefeltro, Duke of Urbino, became a member of the Order of the Garter. Its insignia was incorporated into the decorations of his Renaissance palace and can still be seen today, as can the influence of Renaissance fashions in architecture, including at Linlithgow Palace in Scotland and Hampton Court in England. Giovanni da Maiano (c1486–1542) produced roundels depicting ancient emperors for Hampton Court, while Pietro Torrigiano (1472–1528), designed Henry VII's splendid tomb in Westminster Abbey.

Modern fashions
Ghirlandaio's *Madonna* features a 'Turkish' carpet popular in 15th-century homes

A window onto the world

As trading networks widened and colonisation took hold, Renaissance art revealed the changing face of Europe in the people and goods arriving from afar

While the Renaissance of the 14th to 16th centuries was primarily a European phenomenon, it had important links to the wider world. Italy's location in the Mediterranean placed it at the crossroads of trade between northern Europe, Africa and the Silk Roads leading east to China, and from 1492 there was increasing interest in commodities from the 'New World' too.

The city states of Venice and Genoa facilitated this trade via colonies and trading posts in the eastern Mediterranean and Black Sea. Venice, for example, controlled the islands of Cyprus and Crete, and had a colony in the port city of Acre in what is now Israel, near the modern border with Lebanon. There were many other outposts dotted around the Peloponnese, and all manner of goods passed through them, including lapis lazuli from Afghanistan and spices from Indonesia. Many works of Renaissance art speak to the importance of this trade, incorporating images of Turkish carpets, for example, a popular household accessory in wealthy European homes.

Imagery of the Americas also quickly made it into Renaissance art. Just two years after Columbus's first voyage, pictures of native Americans were included in the frescoes for the new Vatican apartments of Pope Alexander VI (Rodrigo Borgia). This was around the time that his papal bull divided the territories of the New World between the Spanish and the Portuguese.

America got its name from the Florentine explorer Amerigo Vespucci who, prior to his voyage, worked for the leading family of Florence, the Medici, at their bank in Cádiz, Spain. Italian merchants had an important role in financing Spanish and Portuguese colonisation projects in both the Americas and Africa.

Objects from the New World, including pre-conquest manuscripts, featherwork coverlets and turquoise masks all appeared at the Italian courts, as did commodities such as maize and tomatoes and, later, turkeys. Exotic animals (among them a giraffe, elephant and rhinoceros) were sent to Italy from around the world as diplomatic gifts.

There was also trade in people. Isabella d'Este, Marchioness of Mantua, is famous as an art collector, but she asked her agents to purchase an enslaved African girl too. African gondoliers appear in Vittore Carpaccio's paintings of Venice, and Titian's 1523 portrait of Laura Dianti, the mistress of the Duke of Ferrara, shows her with a black page boy. There were also free Africans in Renaissance Italy, including Ethiopian ambassadors who pledged obedience to the Pope, and monks at the church of Santo Stefano in Rome.

European readers came to learn more about Africa thanks to the work of Leo Africanus. Born al-Hasan al-Wazzan in Granada, southern Spain, while it was still under Muslim rule, he likely left after the Spanish conquest of 1492 and ended up in Fez, Morocco, where his uncle was a diplomat. Captured by Spanish pirates in 1518, he was presented to Pope Leo X and converted to Christianity, acquiring fame after death for his book on the cosmography and geography of Africa.

BRIDGEMAN

The London branch of the Florentine Bardi and Cavalcanti company – merchants and bankers who were close to the Medici family – helped facilitate imports of art into the Tudor court, and many English students studied at Italian universities, especially at Padua, among them Henry VIII's physician Thomas Linacre (c1460–1524).

Henry's chief minister, Thomas Cromwell (c1485–1540), also spent time in Italy, first as a mercenary and then working for an Italian bank. In the 1510s Cromwell went to the papal court in Rome to handle paperwork on behalf of religious institutions in England, and is known to have read Italian books, including *The Book of the Courtier*. Written by Baldassare Castiglione (1478–1529), who was born near Mantua but served at the court of Urbino, and published in 1528, *The Book of the Courtier* offered advice on how best to operate at court, and became a bestseller across Europe, inspiring numerous spin-offs and imitations. It remained fashionable in England even after King Henry VIII's break with Rome, as did other Italian literature. Many of Shakespeare's plays take inspiration from Italian sources or are set in Italy: *Romeo and Juliet* takes place in Verona; *Othello* in Venice.

Renaissance women

The Book of the Courtier is notable for its discussion of the abilities of women to participate in government and broader society, with different characters expressing different views. The question of whether women had a Renaissance is a contentious one. There were certainly some aspects of Renaissance life from which women were excluded, notably the political discussions of republican Florence, a city that had an unusually male-dominated political culture. Still, there are significant examples of female artists, writers and patrons.

Vasari's *Lives of the Artists* featured Properzia de' Rossi (c1490–1530), a sculptor from Bologna commissioned to produce work for the city's cathedral. A panel showing Joseph and Potiphar's wife was, according to Vasari, "deemed most beautiful by everyone". The most prominent woman to make a name for herself as a painter in the 16th century was Sofonisba Anguissola (c1532–1625). She became a court painter in Madrid, where she portrayed numerous leading figures at the court of King Philip II. Vasari wrote that she had "worked with deeper study and greater grace than any woman of our times at problems of design". These women paved the way for others later in the 16th and early 17th centuries including Lavinia Fontana (1552–1614) and Artemisia Gentileschi (1593–c1656).

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Making a mark
Self-portrait by Sofonisba Anguissola, one of the best-documented female artists of the Renaissance

The question of whether women had a Renaissance is a contentious one... but there are significant examples of female artists and writers

Literature was an area of culture where women made their mark, beginning with Christine de Pizan (1364–c1430), whose book *The City of Ladies* defended the skills of women. Later, Laura Cereta (1469–99) argued for the right of women to education and was highly critical of the institution of marriage.

The 1530s and 1540s saw a flurry of women's writing in Italy: the poet Vittoria Colonna (1490–1547) is among the most famous, not least because of her correspondence with Michelangelo. Another area in which women had influence was in patronage: high-ranking women including Isabella d'Este (1474–1539), and Lucrezia Borgia (1480–1519) were patrons of art at their own courts.

The Renaissance led to a major shift in European thought. From the city states of Italy in the 14th century, new ideas spread across Europe and were seen in many spheres of endeavour, from art and architecture to music and literature, and from maths and science to philosophy, politics and religion. H

Catherine Fletcher is associate professor of history at Swansea University, specialising in the Renaissance. Her books include *The Black Prince of Florence* (Vintage, 2017)

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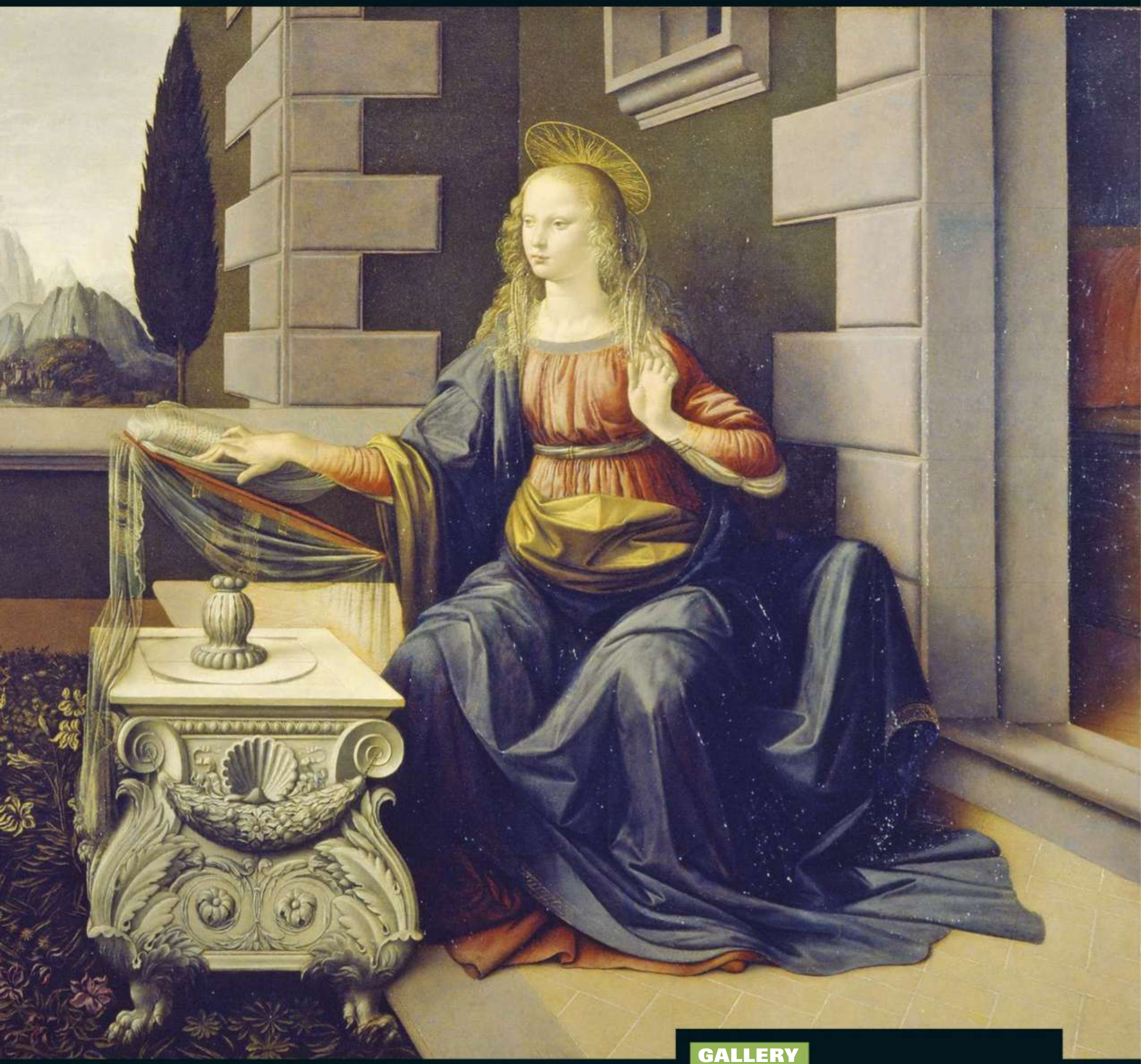
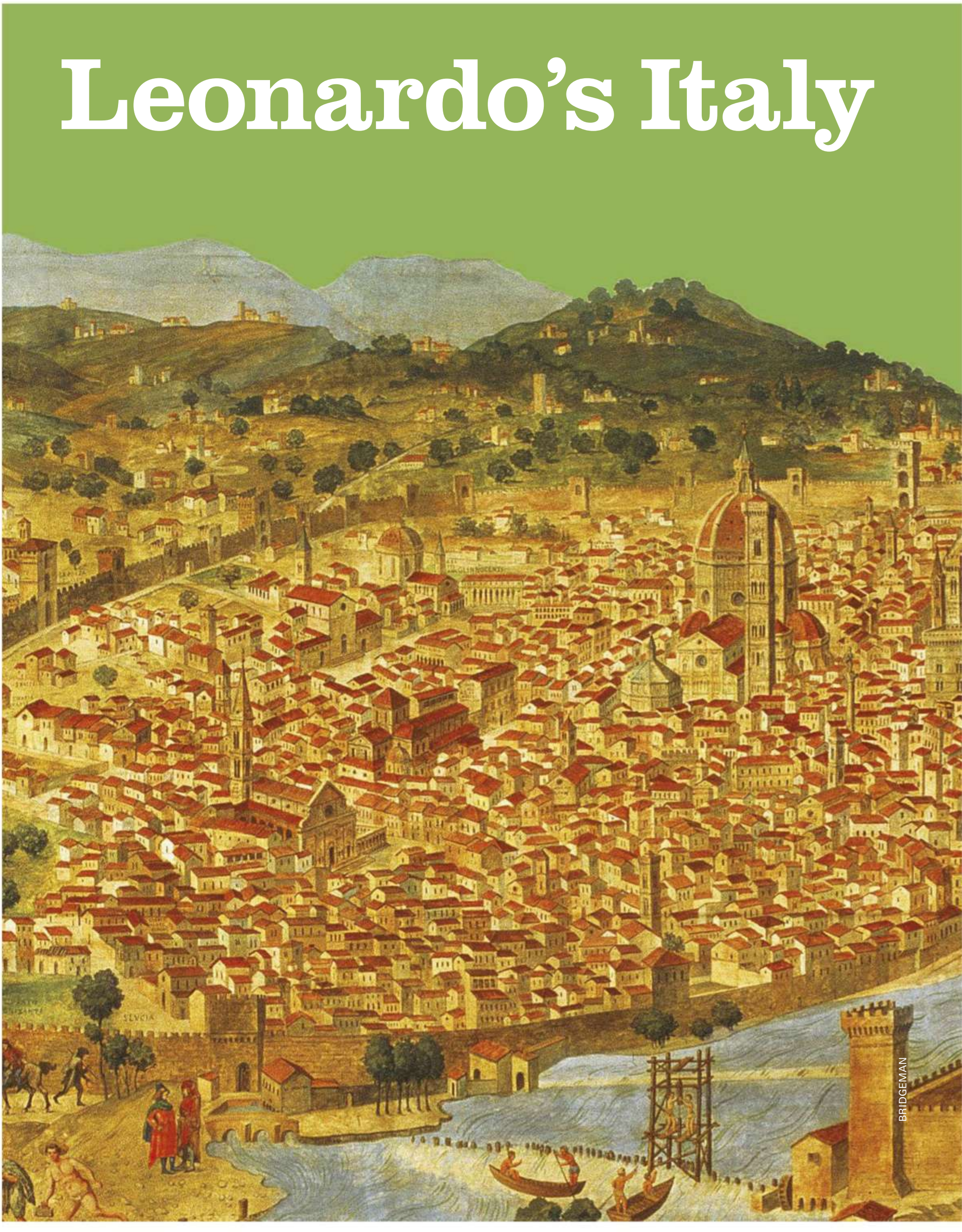


GALLERY

The Annunciation

A painting from c1472, early in Leonardo's career, when the young artist was still working at Verrocchio's studio. The composition puts a traditional religious subject matter in the contemporary setting of a Renaissance palace. The piece demonstrates themes Leonardo returned to throughout his career: the workings of light and vision; careful observation of the natural world; the emotional interaction between figures; and the depiction of ideal beauty.

Leonardo's Italy



BRIDGEMAN

During the Renaissance, Italy was a collection of powerful city states that competed with each other for military and cultural dominance. **Catherine Fletcher** examines the crucial conflicts and political players that shaped Leonardo's world

City of culture
Florence, a focal point of the Renaissance, as depicted in a copy of the *Pianta della Catena* – a map showing the city as it appeared in c1471–82

The city states of Italy c1500

When Leonardo was born in 1452 in the small town of Vinci, west of Florence, it was into a world that was about to see dramatic change. Leonardo's lifetime saw the conquest of Constantinople by the Ottoman sultan Mehmed II, the first European contact with the New World, and the fall of the Mamluk empire in Egypt.

Leonardo's Italy, politically, at least, looked very different to the one we know today. This was not a single country, but a peninsula divided into five large states and many more small ones. Leonardo's home was in the city state of Florence, one of Italy's larger powers; the others were Venice, Milan, the kingdom of Naples and the conglomerate of Papal states in the middle of the country. Smaller states such as Ferrara, Mantua and Urbino were also significant in the politics of the day, and competition between them was both military and cultural, as Leonardo would discover when their rulers vied for his time and skill.

Italy's economy benefited from a geographical location that enabled its merchants to bridge trade along the Silk Road to the east with buyers and sellers in Europe to the north. In 1453, the year after Leonardo's birth, there was a dramatic change in the geopolitics of this Mediterranean world when Constantinople, historic capital of the eastern Roman empire and one of the largest cities in the world, was captured by Ottoman forces (today we know the city as Istanbul, in Turkey).

A great terror

The conquest of Constantinople proved a severe shock in Italy. This was a deeply Christian society, and the fall of such a major centre to a Muslim power caused (in the words of Venetian historian Marin Sanudo) a "great terror" and prompted the Italian states to make peace among themselves. Pope Pius II, who ruled from 1458 to 1464, promised a crusade against the Turks but failed to deliver it. The European rulers on whom he relied for support had their own troubles. The Hundred Years' War between England and France, for example, had just come to an end.

The Italian peace endured, in uneasy fashion, for a good couple of decades. In Florence, these years saw the rise of one of the most celebrated patrons of art and literature in Renaissance Italy: Lorenzo 'the Magnificent' de' Medici. The Medici were wealthy bankers who, through strategic alliances with other city families (often cemented through marriage), exercised informal power in the Florentine republic.

The conquest of Constantinople caused a "great terror" and prompted the Italian states to make peace among themselves

Observers saw this for what it was: Cosimo the Elder, Lorenzo's grandfather, was "king in all but name", wrote Pius II. As time went on, and their banking fortunes faltered, the Medici became increasingly dependent on the income they earned from their public roles in city government.

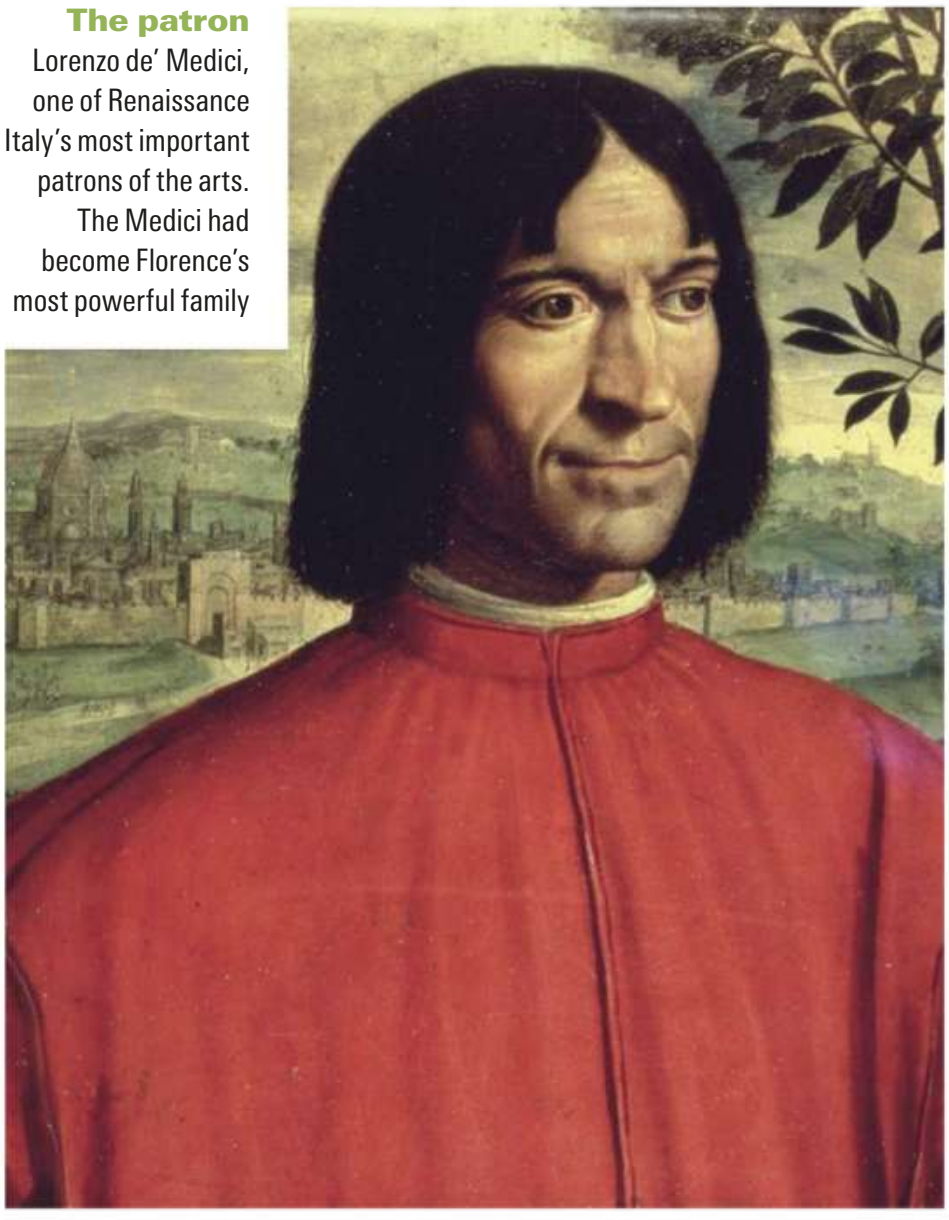
From the point of view of artists, the Medici were very desirable patrons indeed – as were their Florentine rivals. At this time, lending money at interest was considered by Christians to be a sin (much as it is by Muslims today). Patronage of art for churches and monasteries was one way to atone for such less-than-perfect behaviour, and wealthy families also sought out secular art, often inspired by works from ancient Greece and Rome, to adorn their homes.

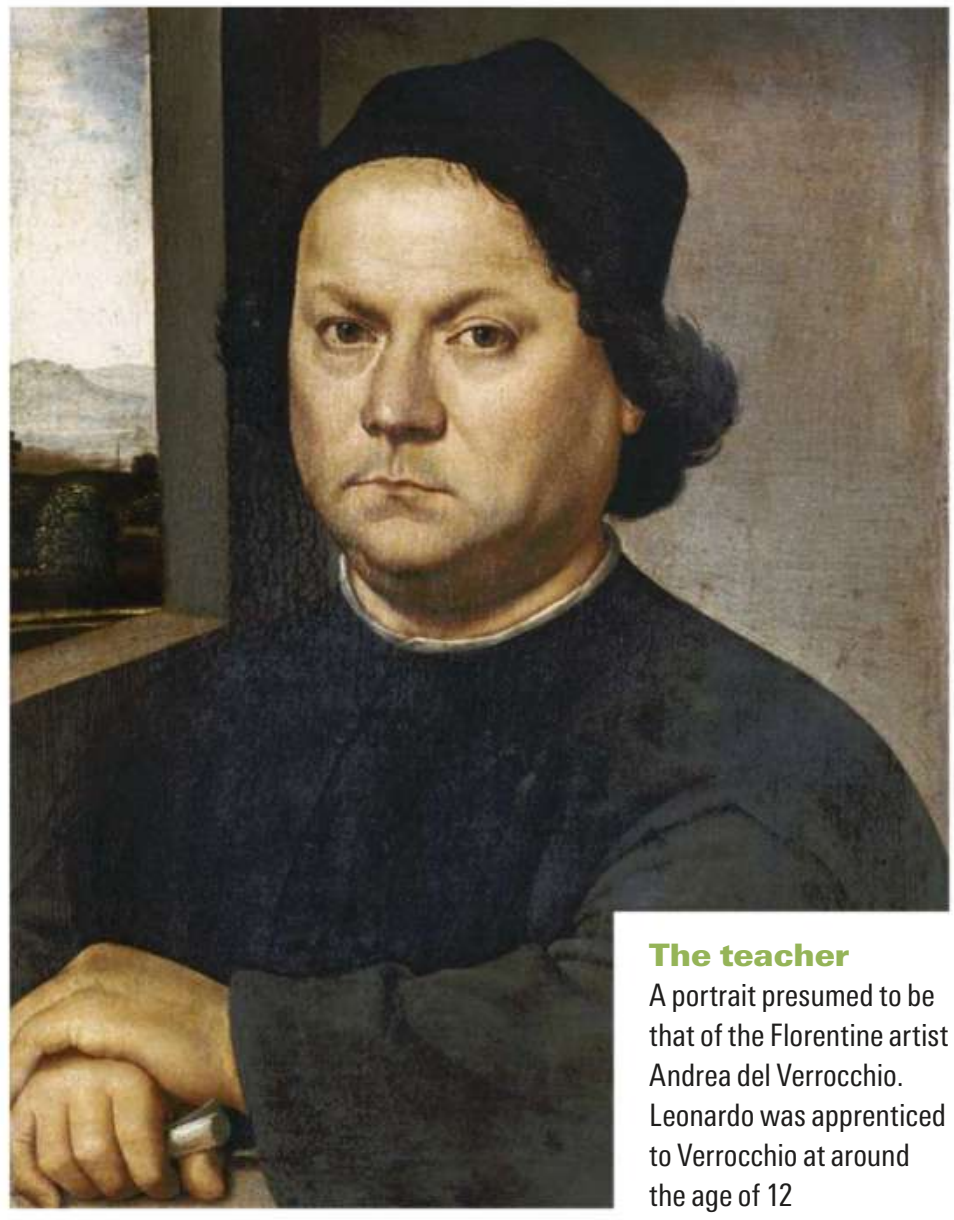
This was the background against which Leonardo da Vinci first joined the workshop of Andrea del Verrocchio, one of Florence's leading artists. We know about Leonardo's presence in the Verrocchio workshop because in 1476 he was anonymously denounced to the authorities for the crime of sodomy, and the report gave Verrocchio's house as his address. It was not at all unusual for a young man in Florence at this time to be accused of sex with other men: in this period, half the male population of the city were on police lists suspected of such crimes. Although sex between men was illegal and considered sinful, it was also commonplace. In 15th-century Florence, there was no sense of a small percentage of people having gay or bisexual identities that are familiar in western societies today. No action was taken over the accusation against Leonardo, and while there is much speculation about the sorts of relationship the artist – who never married – had with his apprentices and

PAUL HEWITT-BATTLEFIELD DESIGN

Holy war
Depiction of the fall of Constantinople to the Ottoman empire in 1453. The Muslim conquest of the city sent shockwaves through Christian Italy

The patron
Lorenzo de' Medici, one of Renaissance Italy's most important patrons of the arts. The Medici had become Florence's most powerful family





The teacher
A portrait presumed to be that of the Florentine artist Andrea del Verrocchio. Leonardo was apprenticed to Verrocchio at around the age of 12

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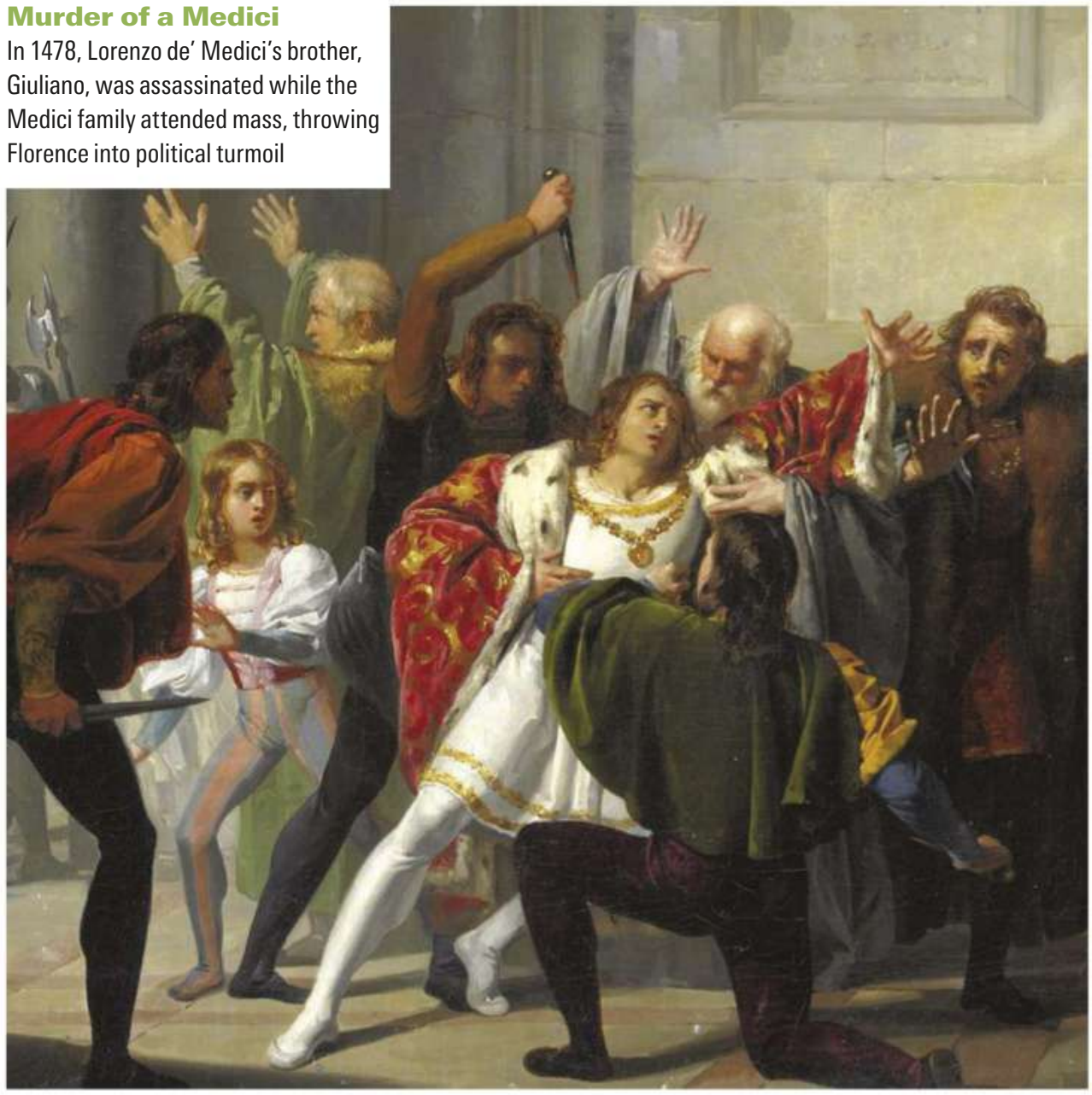

Murder of a Medici
In 1478, Lorenzo de' Medici's brother, Giuliano, was assassinated while the Medici family attended mass, throwing Florence into political turmoil

The preacher
Girolamo Savonarola was a Dominican friar who denounced the power of the Medici and railed against the arts and the sexual immorality of Florence

models, we have no firm information about his private life.

A couple of years later, in 1478, Florence faced huge upheaval in what became known as the 'Pazzi conspiracy'. Giuliano de' Medici, brother of Lorenzo, was assassinated as the family attended mass in Florence's cathedral; Lorenzo narrowly escaped with his life. The conspiracy was backed by Pope Sixtus IV; it threw Florence into turmoil, and only thanks to some impressive diplomacy on Lorenzo's part did the Medici regime recover.

Leonardo's only surviving completed painting in the decade that followed was the *Virgin of the Rocks* (see page 48) produced for the Confraternity of the Immaculate Conception in Milan. Confraternities were an important type of social organisation in 15th-century Italy, combining religious devotion and charitable work with socialising and networking. They could be generous patrons for an up-and-coming artist, and it was Milan rather than Florence that now became Leonardo's home.

Leonardo's decision to absent himself from Florence was probably connected to the changes in Florence as a result of the rise of Girolamo Savonarola. Born in Ferrara in the very same year as Leonardo, Savonarola was a charismatic preacher who had built himself a power base at the Dominican convent of San Marco, a wealthy institution that enjoyed the patronage of the Medici. He became ever more preoccupied with ideas about the coming apocalypse, and was far from alone in this: the 'millenarian' idea that 1500 might prove a cataclysmic moment was widespread. In 1491, Savonarola was elected prior of San Marco, by which time his preaching had led to a falling out with the Medici, whose worldly rule he denounced in a series of sermons for Lent in 1492.

Lorenzo de' Medici died in April that year. His heir, Piero (who came to be nicknamed 'the Unfortunate'), had little of his father's charisma, and Savonarola increased his influence. He excoriated the Florentines for their immorality, targeting 'pagan' books and art and sexual immorality, as well as the tyrannical rule of the Medici: hardly a welcoming environment for Leonardo.

In his sermons, Savonarola targeted 'pagan' books and art and sexual immorality: hardly a welcoming environment for Leonardo

In Milan, meanwhile, the artist had been working first on *Lady with an Ermine* (see page 103) – a portrait of Cecilia Gallerani, lover of Ludovico Sforza, regent of the city – and subsequently on one of his most famous works, *The Last Supper* (see page 66), a fresco in the convent of Santa Maria delle Grazie. But in political terms Milan was no less troubled a city than Florence. Ludovico was ruling on behalf of his nephew Gian Galeazzo, an arrangement that had been fine and good when Gian Galeazzo was a child. Now, however, he had grown up, and with the support of his Neapolitan in-laws decided to assert his right to rule. In turn, Ludovico requested military assistance from the King of France, Charles VIII, and in 1494 Italy was invaded by a French army.

Fall of the Medici

The invasion kicked off a series of wars that lasted 65 years and were the backdrop to the second half of Leonardo's adult life. While the French army swept down the peninsula to Naples, the citizens of Florence kicked out the Medici. Savonarola then established a theocratic regime, but was thwarted in 1498 when he clashed with Pope Alexander VI and was burnt at the stake for heresy.

With the fall of Savonarola and the institution of a republican government that offered a more congenial environment for artists, Leonardo returned to Florence, where in the first decade of the 16th century he worked on the *Mona Lisa*, *The Virgin and Child with Saint Anne* and an enormous fresco of the battle of Anghiari in Florence's seat of government, the Palazzo della Signoria, or Palazzo Vecchio. These three commissions each have a story to tell about

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Invading forces
King Charles VIII of France leads his forces into Florence in 1494 at the start of the First Italian War. The conflict dragged on for 65 years

the society and politics of the time. Mona Lisa herself, otherwise known as Lisa Gherardini (see page 59), came from an old landholding family, and had married an upwardly mobile Florentine merchant, Francesco del Giocondo. Beside extensive interests in the textile trade, Francesco was taking advantage of the opportunities provided by Portuguese colonisation to trade in sugar from Madeira and enslaved African women, some of whom he brought to Florence. News of Columbus's voyage to the New World had now reached Italy; the Florentine Amerigo Vespucci (for whom America was named) travelled there himself in 1499–1500.

In different ways *The Virgin and Child with Saint Anne* and *The Battle of Anghiari* are both products of the Florentine regime's determination to assert its civic pride. Anne was a patron saint of Florence: her saint's day, 26 July, coincided with the republican expulsion of the tyrannical Duke of Athens from the city in 1343. The battle of Anghiari against Milan in 1440 had seen a Florentine victory, which established the city's dominance in central Italy. It was to be accompanied, on the opposite wall, by Michelangelo's fresco of the 1364 battle of Cascina, in which Florence had beaten Pisa. Michelangelo, born in 1475, and thus more than 20 years Leonardo's junior, was a rising star of Florentine art, who had also enjoyed the patronage of the Medici. Neither of these paintings survives, although there has been speculation that remnants survive behind works that covered them when the palazzo was remodelled in the mid-16th century. Most of what we know about them comes from preparatory drawings and later copies.

The monarch
Francis I came to the French throne in 1515 and was Leonardo's final patron

In the service of war

Leonardo's involvement in the wars was not restricted to civic propaganda. While many of his designs – for parachutes, gliders and armoured vehicles – were speculative, he also took a practical military role. After the overthrow of Ludovico Sforza in 1499, he fled to Venice, where he was employed as a military architect and engineer. He also drew up proposals for Sultan Bayezid II, Mehmed II's successor, including for a bridge across the Golden Horn. Despite religious hostility to the Ottoman Turks in Italy, they remained important trading partners. That scheme did not come to fruition, and Leonardo entered the service of Cesare Borgia, son of Pope Alexander VI, who hoped to establish a principality of his own in northern Italy. For Borgia, Leonardo produced a map of the city of Imola, showing a bird's-eye view of its streets that at the time was highly innovative.

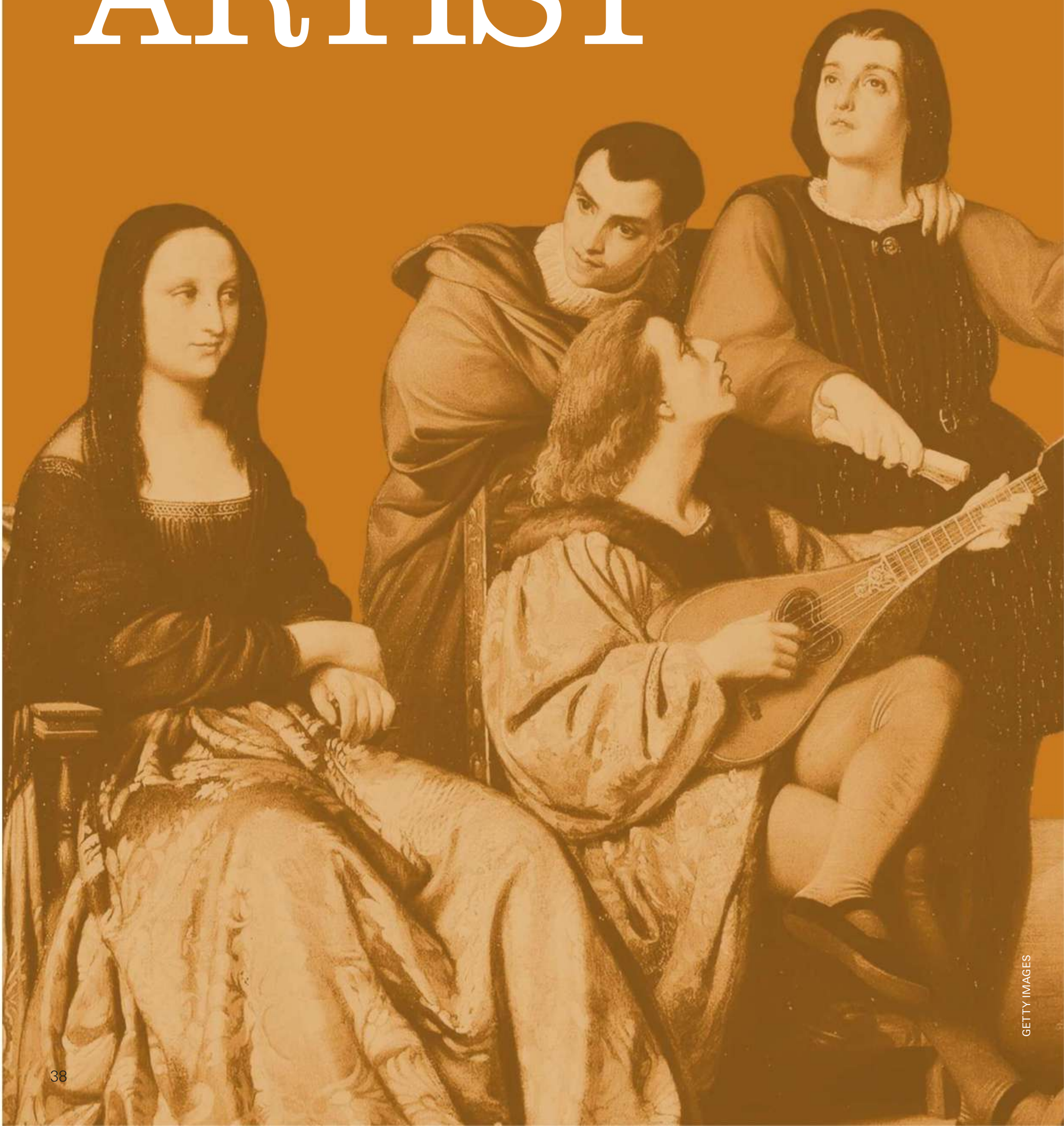
From 1508, now in his mid-50s, Leonardo was back in Milan. Here he produced many of his anatomical drawings, building on his youthful studies of the human body. By this point, his fame allowed him to select both patrons and projects: despite the enthusiasm of Isabella d'Este, the influential Marchioness of Mantua, for a painted portrait, Leonardo completed only a drawing. From 1513, he worked in Rome for the family of newly elected Pope Leo X (a son of Lorenzo de' Medici). The Medici had retaken Florence in 1512 with the support of Spanish troops, and Pope Leo's family now had control in two of Italy's large states.

In 1516, Leonardo made the final move of his life, into the service of the King of France, Francis I. He had made a mechanical lion for the king in 1515, paid for by the Florentine community in the French city of Lyon, to celebrate a new alliance between Florence and France. At this point Francis was the most powerful monarch in Europe (that would change after 1519 when his rival Charles of Spain became Holy Roman Emperor). Alongside warfare and conquest, magnificent cultural patronage enabled Francis to demonstrate his status, and he went on to establish the basis for the French royal art collection now in the Louvre. The *Mona Lisa*, now perhaps less a portrait of an individual woman and more a mythological painting, travelled with Leonardo to France.

Throughout his career Leonardo enjoyed the patronage of the rich and powerful. He died in May 1519 and an account of his death by the art historian Vasari (written three decades later) puts the king at the artist's bedside. This account is probably apocryphal but was popularised by a 19th-century painting and gives us a sense of how highly the artist was valued then, as he has continued to be for five centuries. H

Catherine Fletcher is associate professor of history at Swansea University, specialising in the Renaissance. Her books include *The Black Prince of Florence* (Vintage, 2017)

THE ARTIST



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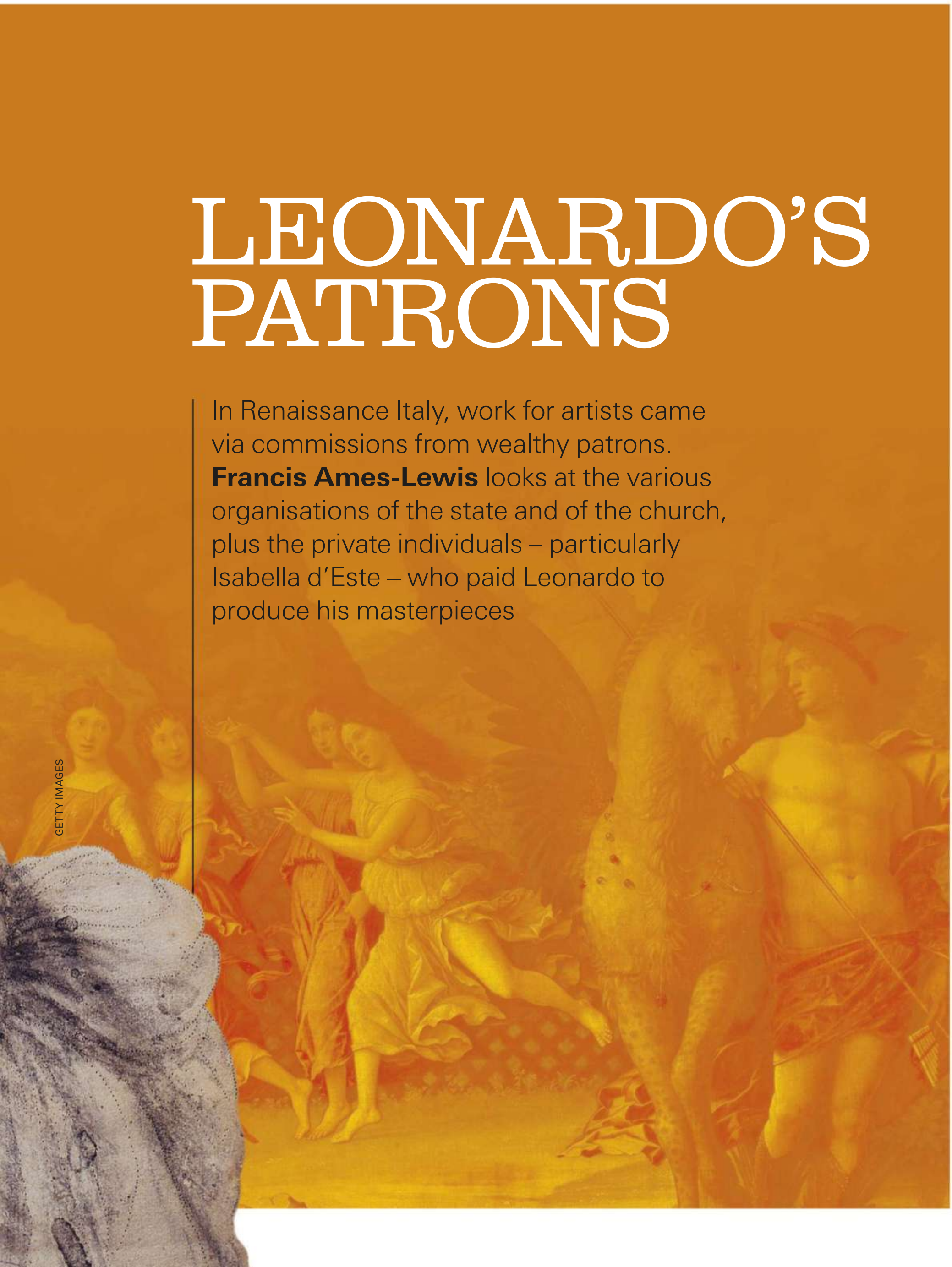
Detail from a mid-19th-century painting by Cesare Maccari, which imagines Leonardo creating the *Mona Lisa*

Portrait of a lady
Leonardo's full-scale cartoon drawing of Isabella d'Este, who admired his work. She commissioned many artists, including Mantegna (whose *Parnassus* is in the background)

LEONARDO'S PATRONS

In Renaissance Italy, work for artists came via commissions from wealthy patrons. **Francis Ames-Lewis** looks at the various organisations of the state and of the church, plus the private individuals – particularly Isabella d'Este – who paid Leonardo to produce his masterpieces



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Artists today generally paint what they wish to paint, hoping to make a living by selling their work at exhibitions or through dealers. But early in the Italian Renaissance, painters were regarded still as craftsmen rather than artists. They were ruled by the conventions of their workshops, and for any major painting commission they were at the behest of a client or patron. The patron might sometimes be benign, allowing their painter some independence, but often they were considerably more demanding. Contracts usually outlined in detail exactly what the painter was to show in his work, and imposed clear conditions on the quality of materials to be used, the delivery date and how much the painter would be paid.

Leonardo da Vinci worked at a time when painters were gaining more freedom to exercise their imagination and individual creativity. But early in his career, he was often constrained by the limitations set by painters' conventional relationships with their patrons. Partly because he kicked against these conventions, he finished relatively few paintings in his lifetime, and left more unfinished than was usual for a painter of his era. For example, his portrait of Cecilia Gallerani (pictured below and on page 103), mistress to his patron Ludovico Sforza, Duke of Milan, was still not complete when it was given to Cecilia by the duke.

More starkly, Leonardo continued for years to work on and off (more off than on, one guesses) at the portrait commissioned around 1503 by the wealthy Florentine merchant Francesco del Giocondo of his wife, Lisa Gherardini: the *Mona Lisa* (see page 59). Leonardo took it with him as he moved to Milan, then to Rome, and finally in 1516 to France, where he went to work at the court of King Francis I. Perhaps he never felt this portrait was finished: it always possessed artistic problems that needed solving. Alternatively, once he had solved these problems in his mind, he lost interest in completing the painting. Either way, his patron never took delivery of the portrait.

Leonardo gained commissions from a range of patrons of widely differing social statuses. He worked for Florentine merchants and

Leonardo always sought employment with patrons who would allow him the freedom to pursue his extraordinary range of interests

Milanese dukes; he painted altarpieces for monks and confraternities, and large-scale murals for aristocrats and republicans. He always sought stable employment with patrons who would allow him the freedom to pursue his extraordinary range of artistic and scientific interests.

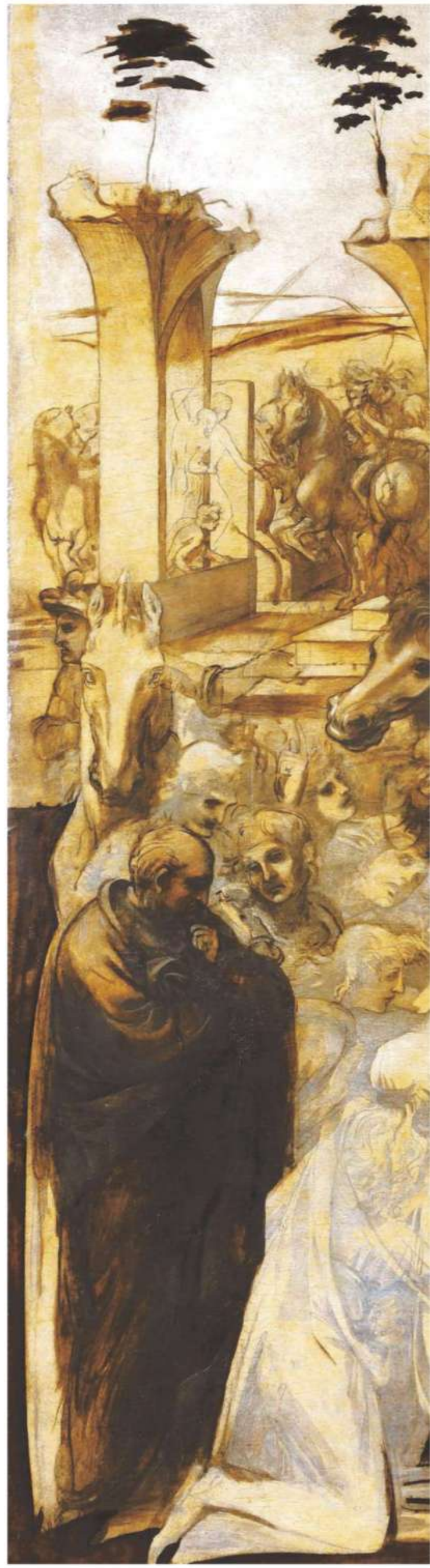
Moving between cities

Leonardo's first large-scale independent work was an altarpiece painting of the *Adoration of the Magi* (pictured opposite), commissioned in March 1481 by the monks of the San Donato a Scopeto Monastery, just outside Florence. They stipulated that he must complete it in 24, or at most 30, months, and that he must himself provide all the pigments and gold leaf needed. But at some point the following year he left Florence, leaving the painting unfinished, and entered the service of the Duke of Milan. This was a near ideal relationship. The time he spent at the Duke of Milan's court was perhaps the most productive phase of his career, both as a painter and as an experimental scientist and creative thinker.

This period of freedom for Leonardo to explore the natural world and to exercise his artistic imagination came to a crashing end with the fall of the duchy of Milan to the armies of the King of France in 1499. But during the politically unsettled years around the turn of the century, Leonardo moved fluently between major sources of patronage, striving to settle on the environment that would offer him the greatest license to work at whatever he wished to pursue.

Leonardo fled from Milan to Venice, where he acted briefly as a military consultant for the Venetian Republic, returning to republican Florence by the end of March 1501. Despite these frequent shifts in

An eye for beauty
Leonardo's portrait of Cecilia Gallerani, *Lady with an Ermine.* The full portrait appears on page 103



Work in progress
Leonardo worked on the *Adoration of the Magi* for the San Donato a Scopeto Monastery in 1481–82, but left it unfinished when he moved to Milan to work for the duke of that city

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First viewing
Leonardo presenting a painting to Duke Ludovico Sforza, a scene imagined in a marble relief by Pietro Magni from 1872

ALAMY

residence, this was a fertile phase in Leonardo's creative life as a painter, although he brought no major commissions to completion. The last 15 years of his career were less productive as he moved restlessly back to Milan, to papal Rome, and finally to Amboise in France where, legend has it, he died in the arms of King Francis I.

Meeting an exceptional woman

En route from Milan to Venice at the end of 1499, Leonardo visited Mantua and there encountered the marchioness Isabella d'Este. An exceptional woman, Isabella was the major female art patron of the Renaissance, sometimes demanding but at other times unexpectedly patient and conciliatory. Isabella's relations as an art patron with Leonardo are unusually well documented, in extensive correspondence held in the Mantuan archive, and tell us a lot about how patronage worked during the Renaissance.

Isabella was determined to be accepted as an equal to her husband in aristocratic authority. This was especially important when she was left in command of Mantua while the marquess was away at war. To this end she undertook traditionally male activities, notably furnishing for herself a private study and forming an important collection of works of art, including a series of small bronze replicas of celebrated classical statues, which she commissioned. Contemporaries such as Federico da Montefeltro, Duke of Urbino, and Isabella's brother Alfonso d'Este, Duke of Ferrara, also decorated their private studies with commissioned paintings. However, Isabella outclassed them in the range and sophistication of her patronage of celebrated artists of her time, and in her determination and acquisitiveness as a collector.

The connoisseur in Isabella also led her to relish making comparisons between classical and contemporary artworks. When a marble carving of a slumbering Cupid that Michelangelo had originally sold as classical was unmasked as his own work, she rapidly acquired it so as to be able to compare it with a classical *Cupid Sleeping*, perhaps by the ancient Greek sculptor Praxiteles, that was already in her collection. Leonardo assisted with one aspect of her collecting activity when, to guide her choice of purchases, he sent her a series of drawings of classical hard-stone vases previously in the collection of Lorenzo 'il Magnifico' de' Medici.

Isabella was also anxious to decorate her study walls with paintings by major artists of her day. These works were to be of exceptionally complex and elaborate allegorical subjects. The Mantuan court painter Andrea Mantegna completed two paintings in this

Telling a story
Parnassus by Andrea Mantegna, 1497, was composed with strict instructions from Isabella d'Este, who is shown as Venus

Isabella was anxious to decorate her study walls with paintings by major artists of her day... of complex and elaborate allegorical subjects

Collector's eye
Isabella d'Este amassed an important collection of artworks including this *Venus Felix*, c1500, a gilded bronze statuette of the goddess Venus

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series, both now in the Louvre, Paris: *Parnassus* (pictured above) and *Triumph of the Virtues*. He was presumably given oral instructions on the contents and meaning of these paintings, but conversely the Umbrian painter Pietro Perugino was sent a written 'poetic invention' for his *Battle Between Love and Chastity*. This required him to include numerous extraneous figures and secondary episodes around the main allegorical action. Correspondence about Perugino's faltering progress, and the finished painting itself, suggest that he had difficulty in formulating a visually pleasing composition. When she finally received the painting, Isabella thanked him but grumbled: "If it had been more carefully finished, it would have been more to your honour and our satisfaction."

Forewarned perhaps by his brother-in-law, Mantegna, the Venetian master Giovanni Bellini in 1501 refused Isabella's commission for a matching allegorical painting. She was told that "he knows your ladyship will judge it in comparison with the work of Master Andrea [Mantegna]" and that "in the story he cannot devise anything good out of the subject at all". In 1506, Isabella tried again, only to be told that "he does not like to be given many written details which cramp his style; his way of working, as he says, is always to wander at will in his pictures".

In March 1501, Isabella wrote to an agent in Florence asking him to "sound [Leonardo] out – as you know how – as to whether he would undertake to paint a picture for my studio. If he should consent, I will leave the invention and the timing to his judgment." Unsurprisingly Leonardo, like Bellini, did not respond well to her proposal, but the

FIVE OTHER PATRONS WHO SHAPED LEONARDO'S CAREER

Isabella d'Este was not the only figure who sought out the artist for his talents

Lorenzo de' Medici

It is often imagined that early in his career, Leonardo da Vinci enjoyed the patronage of Lorenzo 'il Magnifico' de' Medici (pictured below). While he still worked as an assistant of Andrea del Verrocchio, Leonardo may well have worked on Verrocchio workshop projects commissioned by Lorenzo; and there is good reason to believe that in the mid-1470s Lorenzo invited Leonardo to make studies from the classical statuary in the Medici sculpture garden at San Marco in Florence. Further, a contemporary wrote that Leonardo travelled to Milan in 1482 on a diplomatic mission, bearing with him an unusual lute, shaped like a horse's skull, for Ludovico Sforza. However, no record survives of any artistic commissions that Lorenzo de' Medici assigned to Leonardo independently.

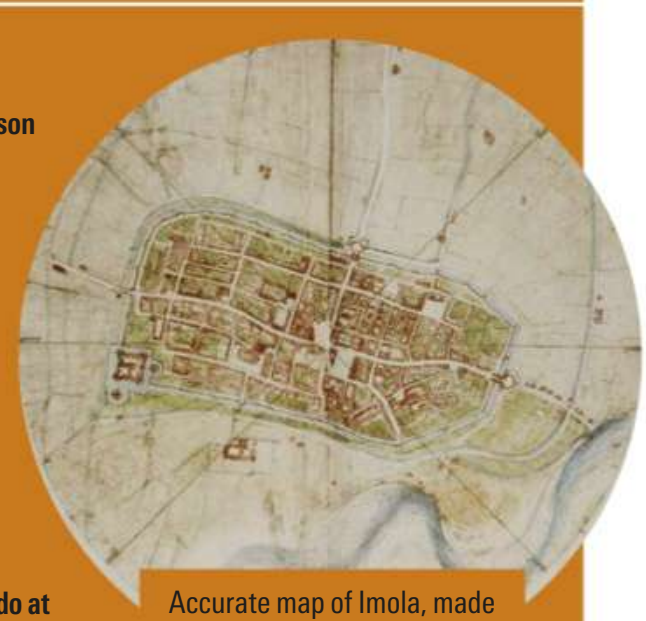
Leonardo's drawings for the bronze equestrian statue of Francesco Sforza, commissioned by his son, Ludovico, Duke of Milan

Ludovico Sforza, Duke of Milan

In the 1480s, Leonardo da Vinci joined the court of the Duke of Milan. He was able to take on artistic work outside the court, and appears to have had the freedom to pursue interests in scientific fields such as anatomy and military engineering. Leonardo also worked on ephemeral projects such as stage designs for theatrical performances and dynastic marriage celebrations. But Duke Ludovico also commissioned portraits, like that of Cecilia Gallerani, and large-scale artistic projects, notably the *Last Supper* mural in Santa Maria delle Grazie, and the equestrian monument to his father, Francesco. By the late 1490s, Leonardo had completed the clay model for the monument, but it was destroyed by invading French soldiers who used it for target practice.

Cesare Borgia

In 1502, Leonardo worked for the warlord Cesare Borgia, son of Pope Alexander VI, whose ambition was to gain and consolidate territory on his father's behalf. On 18 August that year, Borgia directed Leonardo to serve as his consultant on military architecture by surveying his fortifications at cities in the Romagna region, such as Pesaro, Cesena and Rimini. As Borgia's 'architect and general engineer', Leonardo had license to inspect all of Borgia's military installations and to set in train necessary repairs and improvements. This commission included Leonardo's preparation of a highly accurate, colour-coded map of the strategically important town of Imola (shown right). His work for Borgia occupied Leonardo at least until October that year, and possibly for a few months longer.



Accurate map of Imola, made for Cesare Borgia (for larger version see page 105)

Confraternity of the Immaculate Conception

Soon after reaching Milan in c1482, Leonardo was commissioned by the Confraternity of the Immaculate Conception to paint an altarpiece in the Church of San Francesco Grande. The contract, dated 25 April 1483, shows this was an intricate construction incorporating both panel paintings and polychromed sculptures. A list survives specifying the high-quality pigments and gold leaf that the painters had to provide. On the central panel, now at the Louvre, Leonardo and his assistants were to paint "Our Lady with her Son", but the composition is actually more elaborate. A few years later, an argument arose between patrons and painters over this panel's cost. The painters valued it at four times the original estimate, and so another purchaser was found. This may explain why a second painting, started around 1492 to a closely similar composition, was eventually incorporated into the altarpiece.

Virgin of the Rocks, 1483–86, shows the meeting of Jesus and John the Baptist as infants. Turn to page 48 to view the painting alongside its later incarnation

Republic of Florence

In October 1503, the Republican government of Florence commissioned Leonardo to paint a mural of the battle of Anghiari (see page 52). This mural was to decorate part of one wall of the main council chamber in the Palazzo Vecchio – the seat of Florentine government – in the Piazza della Signoria. A year later, Michelangelo was commissioned in competition with Leonardo to fresco another section of this room. Payments over the following months show Leonardo's progress in preparing the wall for painting. The materials he purchased in April 1505 indicate that he proposed to paint not in the traditional fresco technique, but with oil-based pigments on dry plaster. This was a mistake: on 6 June, torrential rain caused his cartoon to come unstuck, and – perhaps due to defective linseed oil – his paint dripped off the wall after he lit a fire to dry it out.

An unlikely story
This 1828 painting of Francis I at Leonardo's deathbed is pure fantasy, but it shows the extent to which the artist's life story became romanticised

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license she was prepared to allow him contrasts sharply with her peremptory manner in dealing with Perugino. This suggests that she accepted that Leonardo deserved gentler treatment. The letter continued "...if you find him reluctant, endeavour at least to induce him to carry out for me a small picture of the Virgin [Mary], devout and sweet as is his natural style". Later on, Isabella appealed directly to Leonardo, writing to ask for "a young Christ of about 12 years old, which would have been the age he was when he disputed in the temple, done with that sweetness and gentleness of expression which is the particular excellence of your art".

Patience and tolerance

Isabella's subtle judgement on Leonardo's style shows a sophisticated perception and an unusual skill in putting it into words. But in April 1501, Isabella heard back from her Florentine contact that "Leonardo's life is changeable and greatly unsettled, because he seems to live from day to day… Since he has been in Florence he has only done one sketch, a cartoon… He gives pride of place to geometry, having entirely lost patience with the paintbrush". Ten days later he wrote again, reiterating that "his mathematical experiments have so distracted him from painting that he cannot endure his brush".

While briefly in Mantua, however, Leonardo had agreed to paint Isabella's portrait. He made a full-scale drawing in preparation (see page 40), and he had this with him when he moved to Venice. But he never painted the portrait, and indeed in 1504, Isabella conceded that now this would be "almost impossible, since you are unable to move here". Almost miraculously, the finished portrait drawing survives in the Louvre in Paris. Its curious, hybrid composition may be a clue as to why Leonardo failed to make the painted portrait. Courtly decorum required that Isabella's head should be portrayed in profile, but Leonardo's artistic instincts led him to draw her torso, arms and hands from the front. The result is an unreconciled contrast between the form and movement of her body and the detached expressionless profile face. It is difficult to imagine that Leonardo can have been content with this awkward compromise, which contrasts uncomfortably with the fluid movement and expression of his Cecilia Gallerani portrait. Isabella seems, however, to have been happy with it, reminding Leonardo in her letter of May 1504 that "when you were in these parts, and did my likeness in charcoal, you promised me you would portray me once more in colours".

King Francis welcomed Leonardo, not so much as a famous painter, but as a celebrated personality who could bring lustre to his court

Isabella d'Este's tolerant treatment of Leonardo is perhaps a signal of how his patrons came to realise that, if they were to receive finished paintings, they needed to provide him with exceptional freedom. Ludovico Sforza seems to have offered him similar license to pursue his scientific investigations alongside his artistic commissions. And King Francis welcomed Leonardo to France perhaps not so much as a famous painter, but as a celebrated personality who could bring lustre to life at his court. H

Francis Ames-Lewis is emeritus professor of history of art at Birkbeck, University of London. He is the author of *Isabella and Leonardo: The Artistic Relationship between Isabella d'Este and Leonardo da Vinci* (Yale University Press, 2012)

GALLERY

Virgin of the Rocks (I)

Leonardo's meeting of Jesus and John the Baptist is innovative, with its naturalistic poses, interaction between figures, evocative landscape and diffuse light. Intended for the church of San Francesco Grande, Milan, this 1483–86 work was instead sent to France, and is now displayed in the Louvre.

BRIDGEMAN

GALLERY

Virgin of the Rocks (II)

This second incarnation, begun c1492, did end up in the San Francesco Grande, but is today at the National Gallery, London. It is not as highly regarded as the Louvre version: parts may be by his assistants, and the faces are not so delicate.

ALAMY

Masters of their art
Michelangelo (left), painted by Daniele da Volterra, c1544, next to a presumed portrait of Leonardo, which is undated

ALAMY/GETTY IMAGES

LEONARDO & MICHELANGELO

THE ENMITY AND THE INFLUENCE

They may have been born a generation apart, but Leonardo could not deny the significance of the young Michelangelo's work. **Martin Kemp** considers the impact that these two giants of the Renaissance had on each other's artistic careers


1


2

Leonardo believed the presence of God was proven by the perfection of nature's inventions, in which nothing was lacking or superfluous

As Leonardo and his friend Giovanni di Gavina were passing the public benches at the Palazzo Spini Feroni, near Florence's Church of Santa Trinita, some men were debating a passage in Dante. They called out to Leonardo, asking him to expound the passage for them. By chance, Michelangelo happened to be passing too, and one of them hailed him. At this, Leonardo declared, "Michelangelo will be able to expound it for you". Michelangelo assumed this was said to entrap him, causing him to reply: "No, *you* explain – you who have undertaken the design of a horse to be cast in bronze but were unable to cast it, and were forced to give up in shame." So saying, he turned his back on them and began to depart. Leonardo remained, blushing at these words. Finally, wishing to humiliate his rival further, Michelangelo called out again: "And to think you were believed by those castrated Milanese roosters!"

Di Gavina, Leonardo's companion, was a painter, now little known. The grand Palazzo Spini Feroni, near the Ponte Santa Trinita, was stripped of its hospitable exterior benches some time ago and is now the home of a fashion museum dedicated to the shoemaker Salvatore Ferragamo. The above anecdote is recounted in an anonymous manuscript, apparently written in the 1540s. Its author is now recognised as Bernardo Vecchietti, an important patron and member of the Medici circle of literati. Recorded during Michelangelo's lifetime, albeit well after Leonardo's death in 1519, it may be taken as an accurate signal of how the relationship between the artistic giants was perceived by those in the know.

The earliest encounters

The two great masters were not of the same generation. Leonardo was born in Vinci in 1452, the illegitimate son of a young lawyer and a peasant girl. By 1500, his career had embraced some youthful years in Florence, and a period in Milan from 1482–99, marked not least by *The Last Supper* (see page 66). Michelangelo, born in 1475, was from a 'good' family, the son of Lodovico Buonarroti, who sometimes worked as a minor Florence official. The young Michelangelo had completed the *Bacchus* and *Pietà* in Rome, but there was no public evidence of his abilities in Florence. In 1501 he was commissioned to make something of a massive marble block in the cathedral workshop. This was to become his *David*.

The first encounter of the artists took place when Leonardo was appointed to a committee to determine where to place the *David*. After much discussion the huge sculpture was placed in the square outside the Palazzo della Signoria (now called Palazzo Vecchio), headquarters of the ruling body of the Republic of Florence.

Inside this palace was a spacious hall, the Salone dei Cinquecento, for assemblies of franchised citizens. It was here that the two artists' work first collided. Leonardo had been commissioned in 1503 to paint a very large mural (probably about 24 by 60 feet) depicting the battle of Anghiari, a victory over the Milanese in 1440. He was to be joined by Michelangelo, whose subject for an adjacent fresco was the battle of Cascina, fought against the Pisans in 1364. Surviving drawings for the project, a copy of Michelangelo's lost cartoon and visual records of Leonardo's unfinished mural demonstrate the divergence in their vision of what art should be.

Leonardo's battle was to depict a bestial conflict of soldiers in elaborate and fantastical costumes, mounted on savage horses. In his account of how to paint a battle, he speaks of dust and smoke in the air, of raining fusillades of arrows, and of foot soldiers thrashing in water and dragged through slimy mud that was saturated with blood. A filmic vision. High drama and intense naturalism were to be mingled.

By contrast, Michelangelo's approach to the battle was to portray a moment of human alarm, when bathing soldiers were alerted by an urgent cry that the enemy were about to attack. Naked men scramble out of the water, some dragging clothes on to damp limbs. As always with Michelangelo, the drama is narrated through the human body. We may imagine, as on the Sistine Chapel ceiling, that the landscape setting was cursory, even abstract.

In the event, the collision of contrasting visions was never to be realised on the walls of the council hall. Michelangelo was summoned to work for the pope in 1505, and

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1 Bestial conflict
A drawing by Rubens, based on the central portion of Leonardo's now lost painting of the battle of Anghiari

2 Faces of fury
Study of two warriors' heads by Leonardo for the battle of Anghiari. The painting was to be a 'filmic vision' of 'high drama'

3 A warrior's body
Study by Michelangelo for his competing fresco of the battle of Cascina, showing a male nude from behind

4 In the melee
A pen and ink sketch by Michelangelo of bodies entangled in hand-to-hand combat for his battle of Cascina fresco

the Florentine authorities reluctantly agreed with the French rulers of Milan that Leonardo should return to the Lombard city in 1506 to serve them. The republic fell to the returning Medici in 1512, and that was that.

Had the works come to fruition, what we would have witnessed on the walls of the council hall would not just have been a clash of styles. For Leonardo's part, he saw the perfection of nature's inventions, where nothing was lacking and nothing was superfluous, as proof of the presence of God. All was in accordance with the mathematical rules that the Creator had established for nature's operations. Leonardo believed the painter's job was to remake nature through a profound study and understanding of it, just as the aspiring aeronautical engineer's job was to understand the flight of birds and bats so as to fabricate a great artificial *uccello* (bird). The necessary understanding was to be achieved by a heroic research of an empirical kind, guided by the mathematics

For Michelangelo, the focus was on the soul within the body, and the striving of human insight to transcend our mortal limits

that ruled at the heart of natural systems. In broad terms, this related to the tradition of Aristotle as understood in the Middle Ages, with a greater emphasis on mathematics than was apparent in Aristotle himself.

Michelangelo, by contrast, adhered to a philosophy that was strongly Platonic in flavour. Instead, the focus was on the soul within the body, and the striving of human insight to transcend our mortal limits. Divine purpose was to be discerned through a vision of beauty and truth realised through God's supreme creation, the human body, which was the house or prison for the immortal soul. The mind, serving the soul, aspired to comprehend divine ideas, as far as this was possible.

When God infuses human life into the receptive Adam on the Sistine ceiling, he is granting the first man's beautiful body a rational soul to accompany the animal and vegetative souls that it already possesses. The degradations of the fallen Adam on the ceiling are preceded by a metaphysical vision that transports us to the transcendental essence of creation, above all, the division of light from darkness. For Michelangelo, the study of nature was largely devoted to the human body. His mastery of anatomy enabled him to create a divine race of beings. For Leonardo, anatomy allowed him to tell us about the actions determined by human minds within the divinely designed mechanism of the body. And, beyond that, Leonardo insisted that nature as a whole – animal, vegetable and mineral – was to be studied and represented with comparable reverence.

The divergence of principle between Leonardo and Michelangelo was profound. It is doubtful whether they ever directly debated these matters, but they did not have to. The difference was readily apparent. Michelangelo was certainly aware of Leonardo's opinions, about which the older artist does not seem to have been reticent. When Michelangelo was asked by Benedetto Varchi in 1549 about the *paragone*, the long-standing debate about the ranking of the various arts, he wrote acidly: "As to that man who

Touched by the hand of God
Detail of Michelangelo's masterpiece, the *Creation of Adam,* on the ceiling of the Sistine Chapel in the Vatican. Michelangelo saw the human body as God's supreme creation

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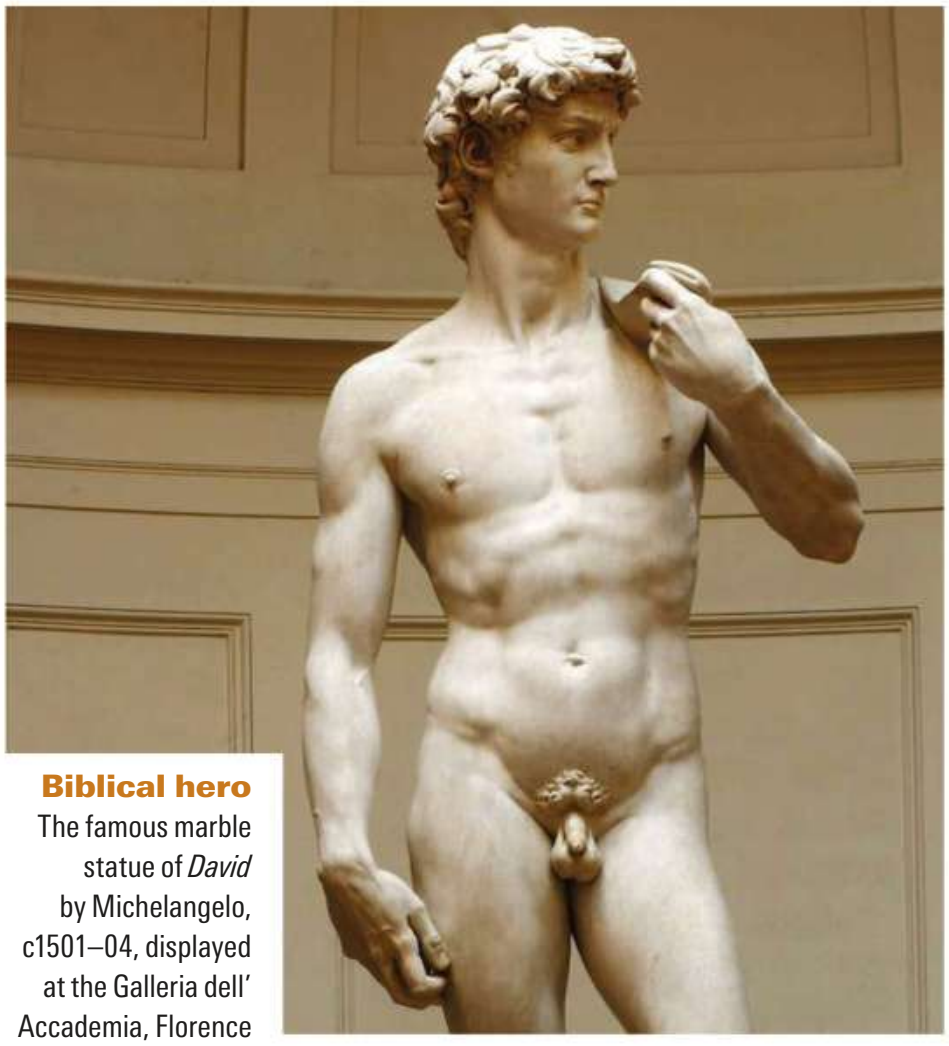
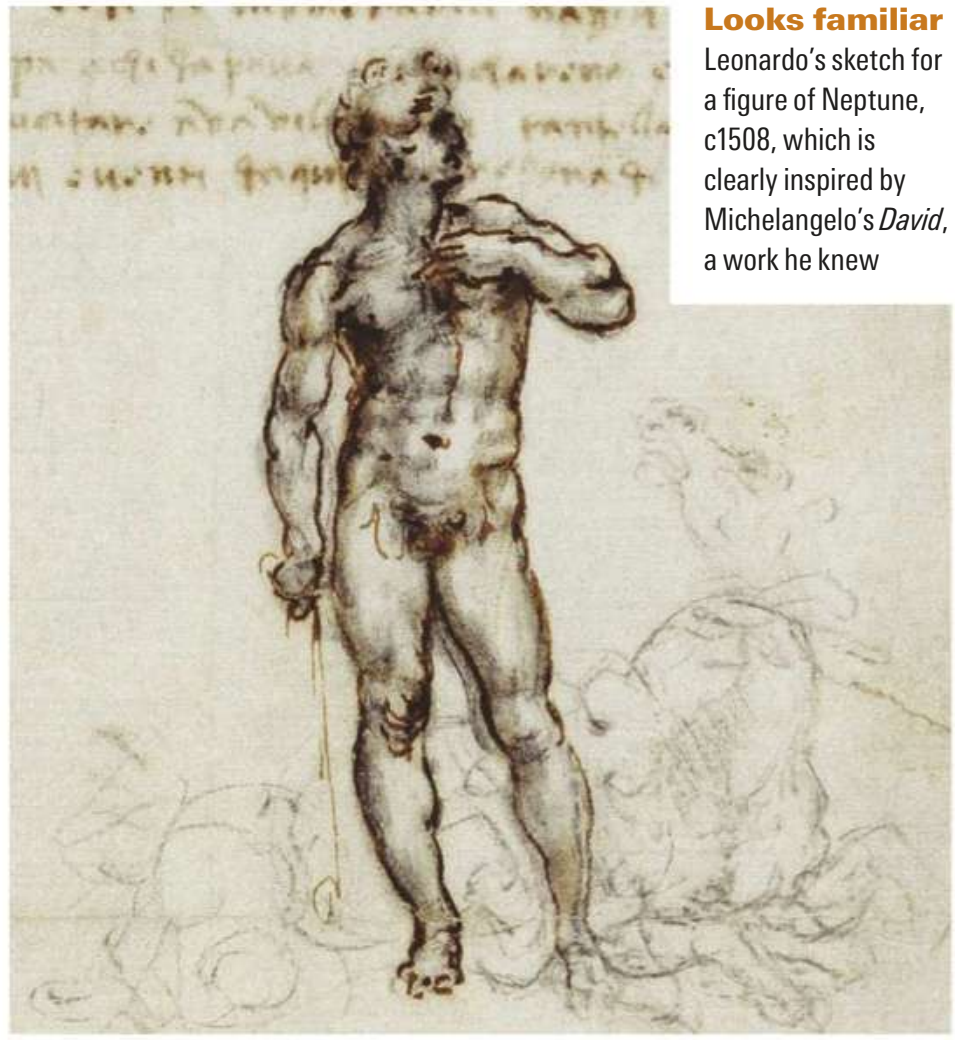
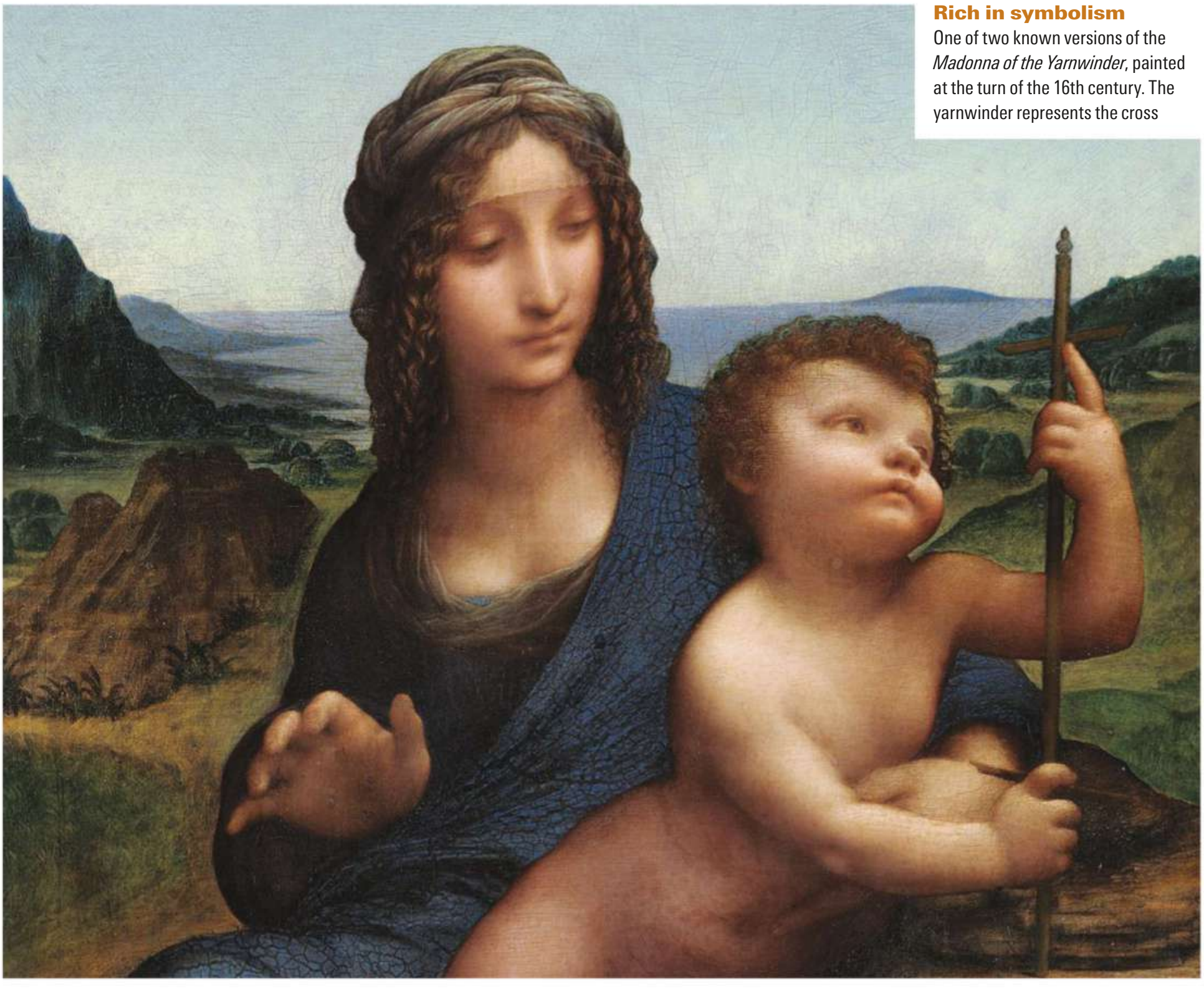


Biblical hero
The famous marble statue of *David* by Michelangelo, c1501–04, displayed at the Galleria dell' Accademia, Florence



Looks familiar
Leonardo's sketch for a figure of Neptune, c1508, which is clearly inspired by Michelangelo's *David*, a work he knew



Rich in symbolism
One of two known versions of the *Madonna of the Yarnwinder*, painted at the turn of the 16th century. The yarnwinder represents the cross

wrote saying that painting was more noble than sculpture, if he had known as much about the other subjects on which he has written, why my serving maid could have written better!"

However, this is not the whole story. Their art was in productive dialogue in Florence during the early years of the 16th century, and in Rome while Leonardo was in the holy city between 1513 and 1516. As a result of his deliberations about where to place the younger artist's *David*, Leonardo had made a small sketch of a more heavily muscled figure to which he added some horses galloping in the foam, converting David into Neptune – perhaps an implicit criticism. It is also possible that Leonardo's warning in his notebook to an un-named "anatomical painter" about the dangers of emphasising musculature for its own sake, resulting in figures that look like bags of walnuts, was a reaction to the heroically defined bodies created by Michelangelo.

A discernible influence

The evidence is more plentiful about the effect Leonardo's art exercised on Michelangelo. When he returned to Florence from Rome in his mid-twenties, Michelangelo was demonstrably affected by what his 50-year-old rival Leonardo was doing. This is most evident in their Virgin and Child compositions. In 1501, Leonardo was painting the *Madonna of the Yarnwinder* (pictured opposite), in which a symbolic reference to Christ's Passion (in this case a device for winding yarn, which resembled the cross on which he would be crucified) is built into the composition as an intense narrative. The child surges across his mother's lap to embrace the cross, while she reacts with uncertainty.

Michelangelo picked up this novel narrative quality in his unfinished marble relief *tondo* (pictured above), a type of circular composition, for the Florentine merchant Taddeo Taddei, in which the awakening Christ reacts with some alarm to the flapping bird (a goldfinch, symbolic of the Passion) proffered by the infant John the Baptist. By 1503, Leonardo had embarked on at least one of his compositions of the Virgin, Child and St Anne (with or without a lamb and St John), the formal and emotional complexities of which were translated into Michelangelo's very different style in his painted Holy Family in the *Doni Tondo*.

Yet beyond such issues of influence, there was a deeper and surprising affinity that they are unlikely to have realised for their own parts. Both artists, in their later creations, were striving to capture the ineffable – the otherness and inaccessibility of the ultimate realm of the spirit. We do not generally think of Leonardo as a spiritual artist, but the *Salvator Mundi* (see page 91) and *St John the Baptist* (see page 102) somehow magically combine his late ideas about the optical uncertainties of vision with an implied sense of a world beyond our earth-bound perceptions. After 1500 – not least after becoming aware of Arabic optical science – he increasingly realised that seeing was a slippery business, and stated that the "eye does not know the edge of any body". There are no rigidly defined edges in his paintings from the *Mona Lisa* onwards.

This optics of uncertainty was complemented by Leonardo's conviction that there was a divine realm outside the finite cosmos, accessible only via faith and not amenable to his beloved reason. As he declared, he did not intend "to write or give information of those things of which the human mind is incapable and which cannot be proved by an instance of nature". He considered that "the definition of the soul" should be left "to the minds of friars, fathers of the people, who by inspiration possess the secrets. I let be the sacred writings, for they are the supreme truth." He goes on to lambast those who "want to encapsulate the mind of God, in which the universe is encompassed, weighing it and mincing it into infinite parts, as if they had to anatomise it". To Leonardo, our only feasible job on earth is to discern God in the perfection of nature.

For his part, Michelangelo, towards the end of his life, was tortured by the inadequacy of his material media of marble, paint and drawing for realising the non-material essence of the holy spirit. As he wrote in one of his sonnets:

So that passionate fantasy, which made
Of art a monarch for me and an idol,
was laden down with sin, now I know well.
Like what all men against their will
desired...

There's no painting or sculpture that
now quiets
The soul that's pointed toward that
holy Love
that on the cross opened
Its arms to take us.

His late Crucifixion drawings somehow dematerialise the figures he sees and the medium in which he represents them. The tension between what is seen in the eye of the mind and our physical eye is extreme.

Leonardo and Michelangelo both confronted a key dilemma of the human condition for the Christian believer: how to deal with the finiteness of our flesh-and-blood existence and the limitations of our minds in the face of divine ineffability. How could we know the divine? Leonardo's visual answer was to use the elusiveness of his own painterly technique to imply a realm beyond the picture to which our rational understanding has no direct access. Michelangelo's desire was always to strive to transcend our manifest limitations and to reach out to a conceptual realm that is not circumscribed by our material existence. Towards the end of his life, he harboured a devastating sense that he was not succeeding.

Leonardo never lost faith in his art, but he must have been aware, as he neared death, how few were the examples of his having manifested his pictorial genius at its supreme level. Michelangelo seems radically to have doubted the power of any art to achieve his ultimate aim. I suspect that neither artist died with a sense of fulfilment. H

Borrowed storyline
In a nod to Leonardo's work, Michelangelo's *Tondo Taddei* shows John the Baptist offering a goldfinch (symbolic of the Passion) to Mary and Jesus

In his mid-twenties, Michelangelo was demonstrably affected by what his 50-year-old rival Leonardo was doing

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Martin Kemp is emeritus professor of history of art at the University of Oxford and one of the world's leading experts on Leonardo da Vinci. His latest book is *Leonardo by Leonardo* (Callaway Arts & Entertainment, 2019)

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Leonardo and Lisa

HOW THE ARTIST MET HIS MODEL

ALAMY

Lisa del Giocondo's portrait is a famous work of art, but little was known about the woman herself until recently. **Giuseppe Pallanti**, co-author of a 2017 book on the subject, delves into her life and explains how she came to be painted by Leonardo

A famous face
Leonardo began painting Lisa del Giocondo in 1503 when she was in her early 20s. It is unclear when the painting (pictured in full, page 63) was finished, but it was never delivered, with Leonardo choosing instead to keep it with him

City streets
Detail from the *Pianta della Catena*, a 19th-century painting of Renaissance Florence based on a design by Francesco di Lorenzo Rosselli, c1471–82

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Encased behind bullet-proof glass in the Louvre, Leonardo da Vinci's *Mona Lisa* is arguably the most famous work of art in the world. Widely referenced in popular culture and a source of intrigue for historians and psychologists alike, the portrait attracts millions of visitors each year – all eager to capture a glimpse of the sitter's enigmatic smile. But who was 'Lisa'? And how did she come to have her portrait painted by Leonardo?

Although the painting has come to take on a legendary status, its origins are somewhat unremarkable. In fact, through careful research, we can establish beyond all reasonable doubt that it was simply intended to be a portrait of a Florentine woman named Lisa del Giocondo (née Gherardini), commissioned by her wealthy husband.

Lisa was born in Florence on 15 June 1479, in a property that her parents had rented from the Corbinelli family, wealthy merchants from Oltrarno in Florence's south. Her father, Antonmaria di Noldo Gherardini, was descended from an ancient and noble but fallen Florentine family; her mother, Lucrezia di Galeotto del Caccia, was the daughter of a rich wool merchant.

Lisa spent the first years of her life living among some of the narrowest, darkest and most notorious streets in Florence. The house of her birth, located in the city's south, on the corner between Via Maggio and Chiasso Guazzacoglie – today known as Via Sguazza – was a malodorous alley where water quickly stagnated.

The family lived for a few years within the vicinity of Santo Spirito church in Oltrarno, but in 1494 they relocated again to the more upmarket Santa Croce district, in a house next to that of her grandfather Galeotto, who had begged a neighbour to host the family in his home. The new house was located in Via de' Buonfanti – today Via de' Pepi – near Via Ghibellina and the house of Ser Piero, Leonardo's father.

In March 1495, at the age of 16, Lisa became the second wife of Francesco del Giocondo, a widowed merchant whose family had made a fortune in the silk trade in Italy and across Europe. Although Francesco was a skilled businessman, he was no stranger to controversy. At several points in his career he was convicted of usury and other abuses, and was even labelled by judges as *garoso* – a term to describe a bold and arrogant individual who pushed the law to its limits.

Birthplace
Lisa Gherardini was born and spent the first years of her life in a house on the narrow Florentine street of Via Sguazza

At 16, Lisa became the second wife of Francesco del Giocondo, a widowed merchant whose family had made a fortune from silk

Following their marriage, Lisa went to live with Francesco in his palace in Via della Stufa, located in the district of San Lorenzo, a maze of alleyways filled with shoppers during the day and prostitutes at night. However, Francesco also owned an elegant estate on nearby Montughi Hill, where the couple would retire during the summer months. Simply known as 'Francesco del Giocondo's place', it boasted beautiful views overlooking the rooftops of the city below.

Lisa soon became pregnant and eventually gave birth to six children over the course of the next decade: Piero (1496–1569); Piera (1497–99); Camilla (1499–1518); Marietta (1500–79); Andrea (1502–c1536) and Giocondo (1507–1508). In addition to her own children, Lisa also raised Bartolomeo, who was Francesco's young son from his first marriage.

A merchant's life
Detail from a Renaissance painting of an Italian wool merchant transporting his stock by donkey

GIUSEPPE PALLANTI/SHUTTERSTOCK

Crossing paths

While Lisa was busy tending to her growing brood, Leonardo was working in the court of the Duke of Milan, where he had been employed since c1482. However, following the invasion of the city by Louis XII's forces, Leonardo

returned to Florence in April 1500 and took up residence in the guest quarters of the Santissima Annunziata monastery, largely thanks to the influence of his father Ser Piero, who had been the monks' notary for more than 30 years.

After such a long absence from Florence, Leonardo had lost contacts and felt like a stranger to the family of his father, who was now living with his significantly younger fourth wife and a dozen children from previous marriages. Despite being commissioned to paint an altarpiece in the Annunziata monastery, Leonardo left Florence for a second time to briefly serve in the court of Cesare Borgia, Duke of Valentinois, as a military engineer.

When he returned to the city again in the spring of 1503, Leonardo had no income and was forced to withdraw a large portion of the savings he had previously deposited at the hospital of Santa Maria Nuova. It was around this time – shortly before commencing work on a mural on the battle of Anghiari (see page 52) – that he began painting the portrait of Lisa del Giocondo at the request of her husband.

Indeed, a recently discovered note written in the margin of a book kept by Leonardo's friend Agostino Vespucci, marked October 1503, recalls that the artist had been working on a painting of "the head of Lisa del Giocondo", meaning it had definitely been started by that date.

In need of work, Leonardo would have known that Francesco del Giocondo had amassed a considerable fortune and would therefore have no difficulty in paying for the portrait. But it seems likely that Leonardo was already long acquainted with the family by the time he accepted the commission. Not only had his father known Lisa's grandparents for 15 years as his neighbours in Via Ghibellina, but Ser Piero may have even attended Francesco and Lisa's wedding. In 1497, Ser Piero had also drafted a legal contract between Francesco and the monks of the Santissima Annunziata, which the merchant regularly attended.

Some of the most interesting insights into the origins of the *Mona Lisa* come courtesy of the painter, architect and writer Giorgio Vasari (1511–74). Often regarded as the earliest 'true' art historian, Vasari was the first to formally identify the sitter as being Lisa del Giocondo, wife of Francesco. Vasari was certainly well informed about the works of art commissioned by the Giocondo family. He knew Francesco's cousins personally and had seen the masterpieces that hung in their houses. In fact, as a young man, Vasari may have even met Francesco himself while he was apprenticed to the artist Andrea del Sarto, whose workshop was next to the Annunziata monastery.

Leonardo knew that Del Giocondo had amassed a considerable fortune and would have no difficulty paying for the portrait

Most compellingly, when writing the second edition of his famous volume *Lives of the Most Excellent Painters, Sculptors and Architects* in 1568, it seems possible that Vasari was able to obtain further information on the subject from his neighbour in Via Larga (today Via Cavour) – who just so happened to be Lisa's eldest son, Piero del Giocondo. Although Vasari was too young to have seen Leonardo's original painting of Lisa and would have referred to copies, he was able to provide a description of the portrait, emphasising the finesse of the details, the natural qualities of the figure and its extraordinary vitality.

Expert witness

Self-portrait of the artist and art historian Giorgio Vasari, who knew the Del Giocondo family and whose testimony identifies Lisa as the subject of Leonardo's painting

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In other words, his testimony seems credible, and when he penned the now-famous passage, "Leonardo undertook to paint for Francesco del Giocondo a portrait of Mona Lisa, his wife, but having spent four years upon it, left it unfinished," we can assume Vasari wrote with knowledge of the facts, and not carelessly.

Following the paper trail

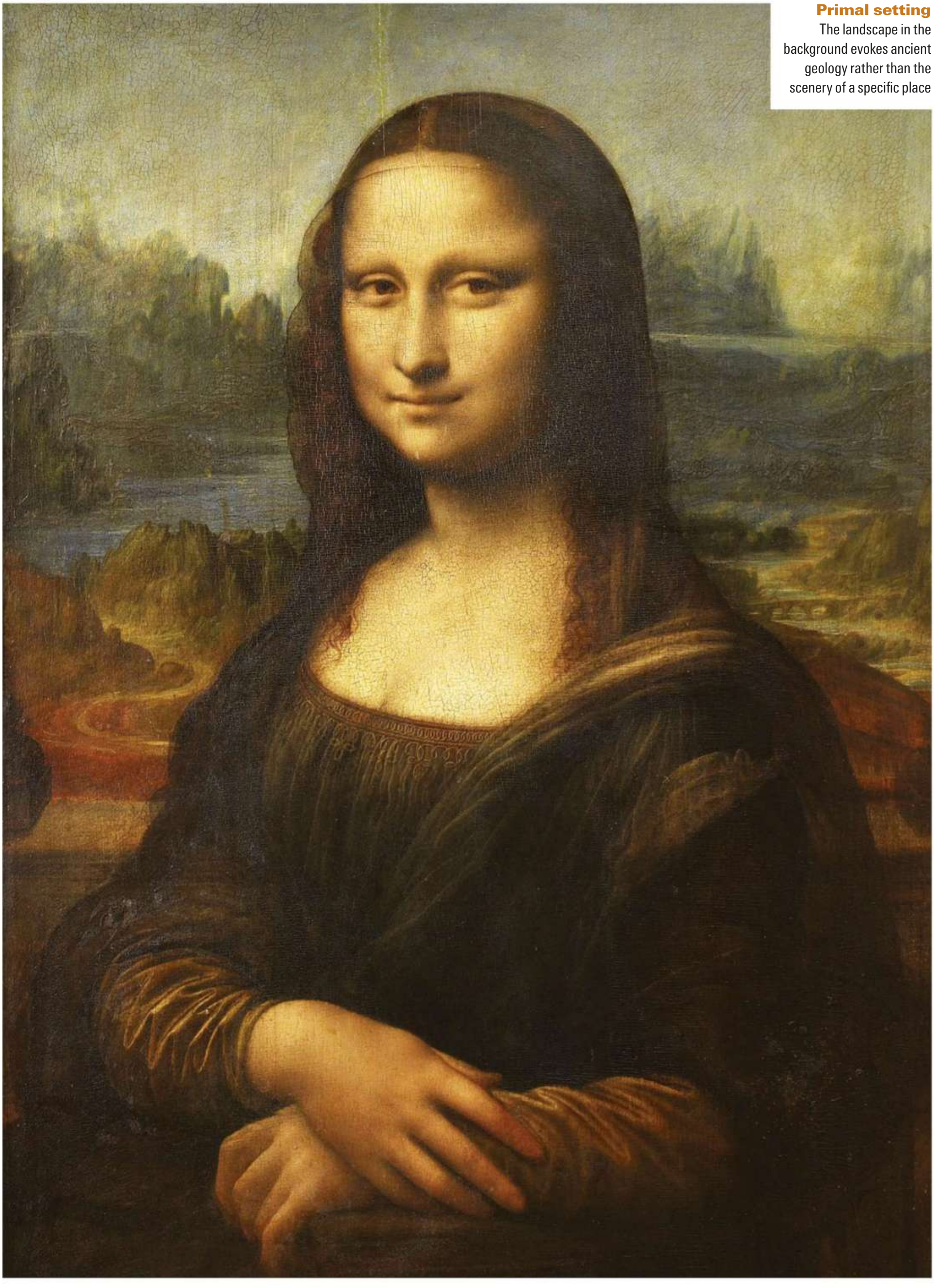
As indicated by Vasari, Leonardo struggled to complete his painting. When he eventually left Florence for good he carried the painting, which is on a panel of poplar wood, around with him and never presented the results to Lisa or indeed Francesco, who had commissioned the work in the first place. But while the portrait's subsequent movements in France are well documented (see 'Mona Lisa: from wife to wonder woman', page 65), the lives of the sitter and her family have remained elusive until fairly recently.

From local records we know that Francesco initially conducted his business affairs in partnership with his cousins, but this arrangement appears to have come to an end by 1510. Instead, Francesco went on to set up his own company, trading fabrics and products such as wool and wax from Spain, leather and hides from Ireland and sugar from the island of Madeira. A decade later, when he judged that his commercial activity had become too risky, he changed strategy and became a landowner, with farms in Chianti and a large estate on the Pisa plain.

Francesco and Lisa's sons followed in their father's footsteps and continued running the family business, with Bartolomeo and Piero remaining in Florence, and Andrea leaving the city to open a shop in Antwerp. Due to financial difficulties, Piero would later sell the family house in Via della Stufa and move into a smaller property in Via Larga, near Piazza San Marco, where he would have likely encountered Vasari in the 1550s.

However, it is by tracing one of the couple's daughters, Marietta, that we find further clues about Lisa herself. While her elder sister, Camilla, had joined the convent of San Domenico di Cafaggio before her death in 1518, Marietta (who later became known as Sister Ludovica) was placed in the nearby convent of Sant'Orsola, with which Lisa appears to have had a strong personal connection.

Indeed, records show that Lisa regularly visited and supported the nuns with alms or by purchasing their products – such as when she bought "snail water distillate", which was probably used for cosmetic or



Primal setting
The landscape in the background evokes ancient geology rather than the scenery of a specific place

ALAMY

Final resting place
The now abandoned and derelict convent of Sant'Orsola, Florence, where Lisa spent her final days and was later buried

Sunny cloisters
The Chiostro dei Morti (cloister of the dead) of Santissima Annunziata monastery. The Del Giocondo family tomb is inside the church

antibacterial purposes. At other times, she sold cheese made at the convent from the family farm. Each time, she was recorded as "Mona Lisa del Giocondo" – that is, Francesco del Giocondo's wife.

Lisa died in 1542, four years after her husband, in the convent of Sant'Orsola. Testament to her close connection with the convent is the fact that this was also where she was buried, and not in the family tomb built by Francesco, which was located inside the Annunziata church.

A 'universal picture'

Although Leonardo may have started his painting by portraying the wife of Francesco del Giocondo, the artwork we know today is likely to be different from what was originally intended. Having been reworked so many times over the following years, it seems possible that the *Mona Lisa* instead represents an idealised figure, rather than a real woman. In fact, even the landscape in the background of the image is not a real setting. While some experts have suggested that it was inspired by the mountains of Lombardy or Valdarno, overall, the scenery seems to evoke ancient geological processes and the changes of the earth, more than the landscape of one particular place.

Reworked so many times over the following years, it seems possible that the Mona Lisa represents an idealised figure, rather than a real woman

In the words of art historian Martin Kemp, what began as a portrait of a specific individual evolved into a "universal picture" into which Leonardo "poured all his knowledge about optics, vision, psychology, human communication, anatomy, geology, water and the behaviour of materials". As a result, this little panel is a synthesis of Leonardo's complex and extraordinary activity, a symbol of both his artistic experience and his scientific knowledge. H

Giuseppe Pallanti is a Florence-based economist with a passion for archival research. With Martin Kemp, he is co-author of *Mona Lisa: The People and the Painting* (Oxford University Press, 2017)

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FROM WIFE TO WONDER WOMAN

MONA LISA

Martin Kemp examines the portrait's remarkable legacy, charting its journey from Leonardo's studio to the Louvre

How was it that a smallish painting of the bourgeois wife of an opportunist trader in Florence became the world's most famous visual image? She (or perhaps 'it') is famous for being famous, but that kind of celebrity does not persist for more than half a millennium without some other reason.

The key explanation is its absolute 'quality': the quality of painterly magic that endows her with a presence that is uncomfortably assertive yet tantalisingly elusive; the psychological quality of her enigmatic stare and teasing smile; the virtuoso quality of her draperies with their translucent veils, the rivulets of gathered silk and shiny folds of stiffer cloth; the geological quality of the visionary landscape traversed by what Leonardo called its "veins of water" and mountainous "bones". At the core of these effects is Leonardo's optics of uncertainty, which requires each of us to exercise our imaginations. He put so much of what he thought painting could do into this one picture that we can always extract something new. It transitioned from a commissioned portrait into what I have called a "universal picture".

The painting's special status was recognised early. The first biography of Leonardo, in Giorgio Vasari's seminal *Lives of the Artists* in 1550, provided a vivid description: "In this head, anyone who wishes to see how closely art could imitate nature, may comprehend it with ease; for in it were counterfeited all those tiny things that only with subtlety can be painted, seeing that the eyes had that lustre and watery shine which are always seen in life, and around them were all the vivid rosy tints of the skin." He had probably never seen the original, but knew those who had, and understood that it was special. Leonardo himself showed it to visitors and kept it with him until his death in France in 1519.

At some point after that date it entered the French royal collection, where it was prized as a masterpiece. In 1625, Cassiano dal Pozzo, Roman patron, collector and antiquarian, tells how "The Duke of Buckingham, sent from England to accompany back the wife [Henrietta-Maria] of the new English King [Charles I], expressed his desire to acquire the portrait, but the King of France was strongly dissuaded by several people who put it to his Majesty that he would thus deprive the kingdom of the finest painting in his possession." Buckingham had to settle for a copy.

Leonardo put so much of what he thought painting could do into this one picture that we can always extract something new

ALAMY

The ascent of the *Mona Lisa* into the wider public domain came in the 19th century, when authors of a romantic bent exploited her ambiguous presence to transform her into a fêmme fatale. Théophile Gautier, looking at the painting in Paris, went to extremes: "...the sinuous, serpentine mouth, turned up at the corners, under violet-tinged shadows, mocks you with such sweetness and grace and superiority, that you feel wholly timid like a schoolboy before a duchess." Walter Pater in England was no less effusive: "She is older than the rocks among which she sits; like the vampire, she has been dead many times, and learned the secret of the grave; and has been a diver in deep seas, and keeps their fallen day about her; and trafficked for strange webs with eastern merchants..."

Engravings and then photographs propagated Lisa's uncanny image, in concert with the rising fashion for tourists to visit major collections. When in 1911 the panel was sensationally stolen with much good luck by the naive Vincenzo Peruggia, an Italian odd-job man who had been working in the Louvre, those queuing to see the empty space outnumbered those who had earlier visited to see the real thing. Picasso was among those questioned by the police. When Peruggia attempted to repatriate it to Italy late in 1913, he was arrested, and the painting was returned. It has widely been claimed that this incident triggered *Mona Lisa*'s fame. But it was stolen because it was famous, and the press exploited its well-established celebrity.

During the course of the 20th century, its rise was continuous and irresistible, whether defaced with a moustache by Marcel Duchamp, used to advertise almost anything, caricatured to exhaustion, serially repeated by Andy Warhol, or the subject of lurid fiction. It is impossible to view it properly in the Louvre. I have seen the portrait twice out of its frame. It has a true living presence, some sense of which somehow survives even in all the low-grade reproductions. It deserves all the fame it can get. H

Martin Kemp is emeritus research professor of history of art at the University of Oxford and one of the world's leading experts on Leonardo da Vinci

GALLERY

The Last Supper

This wall painting in the Dominican monastery of Santa Maria delle Grazie, Milan, allowed Leonardo to explore how the body communicates inner states of being. The disciples, devastated by Christ stating one of them would cause his death, convey their feelings dramatically through their body language. Commissioned in the 1490s by the Duke of Milan, the huge painting is 4.6m × 8.8m. It deteriorated quickly and has been damaged several times, leading to many restoration attempts.

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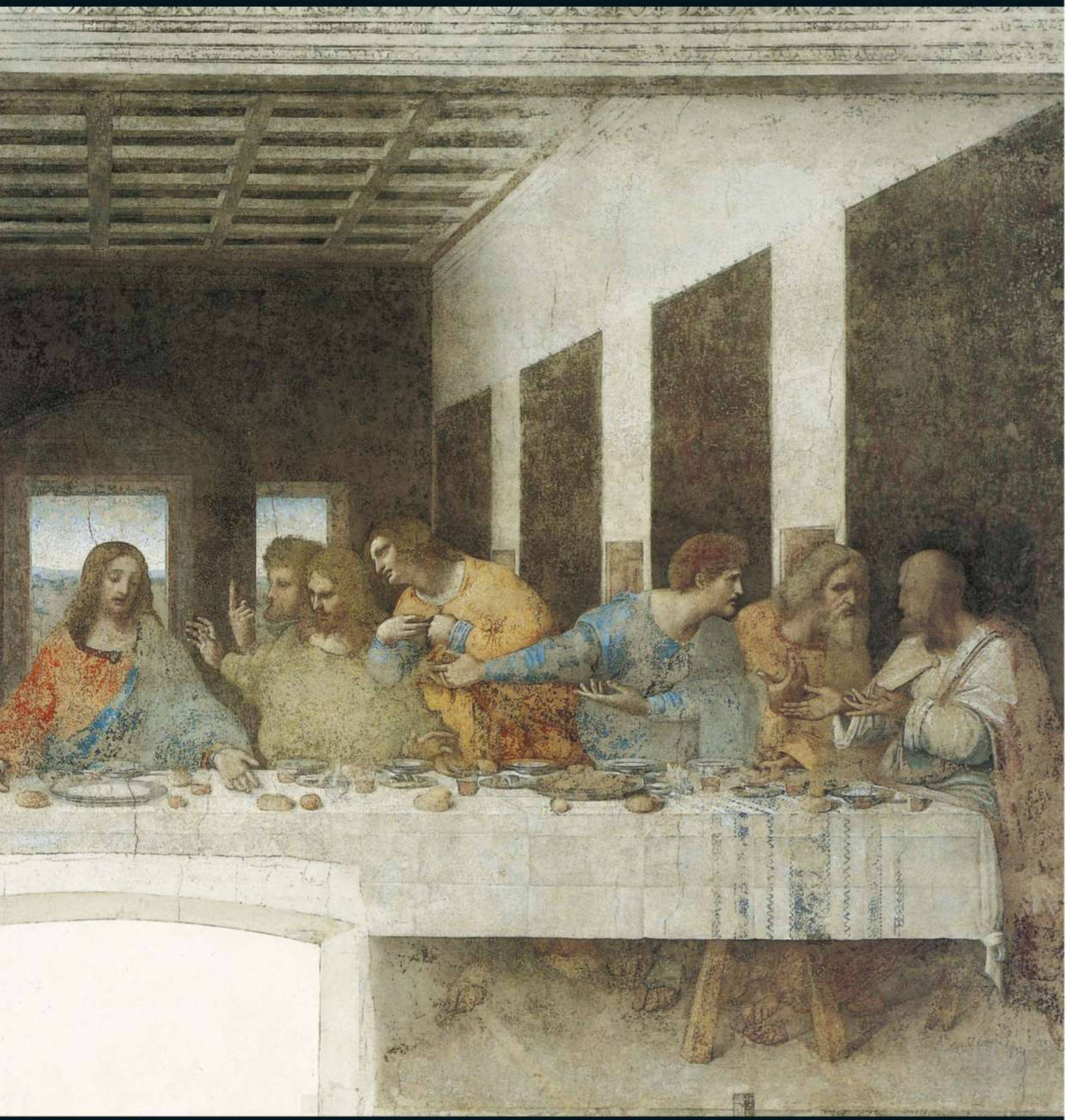


LEONARDO DA VINCI: A LIFE IN DRAWING

After going on display in 12 cities across the UK earlier this year, dozens of Leonardo's drawings from the Royal Collection are now being brought together for two landmark exhibitions, in London and Edinburgh. Curator **Martin Clayton** reveals the stories behind some of the highlights

CURATING LEONARDO

Britain's Royal Collection is one of the largest art collections in the world. Included within this treasure trove are hundreds of drawings by Leonardo da Vinci, first acquired by King Charles II in the late 17th century and currently housed at Windsor Castle. From pioneering studies on anatomy to preparatory sketches for masterpieces such as the *Last Supper*, the drawings demonstrate the extraordinary breadth of Leonardo's artistic and scientific interests, while also offering a unique insight into the workings of his mind.

To mark the 500th anniversary of Leonardo's death, a total of 144 drawings were exhibited at galleries across England, Scotland, Wales and Northern Ireland during early 2019, attracting in excess of a million visitors. These have now been brought together for the largest display of Leonardo's work in 65 years at The Queen's Gallery, Buckingham Palace (24 May – 13 October 2019), with 80 drawings also due to be exhibited in Edinburgh at The Queen's Gallery, Palace of Holyroodhouse (22 November 2019 – 15 March 2020).

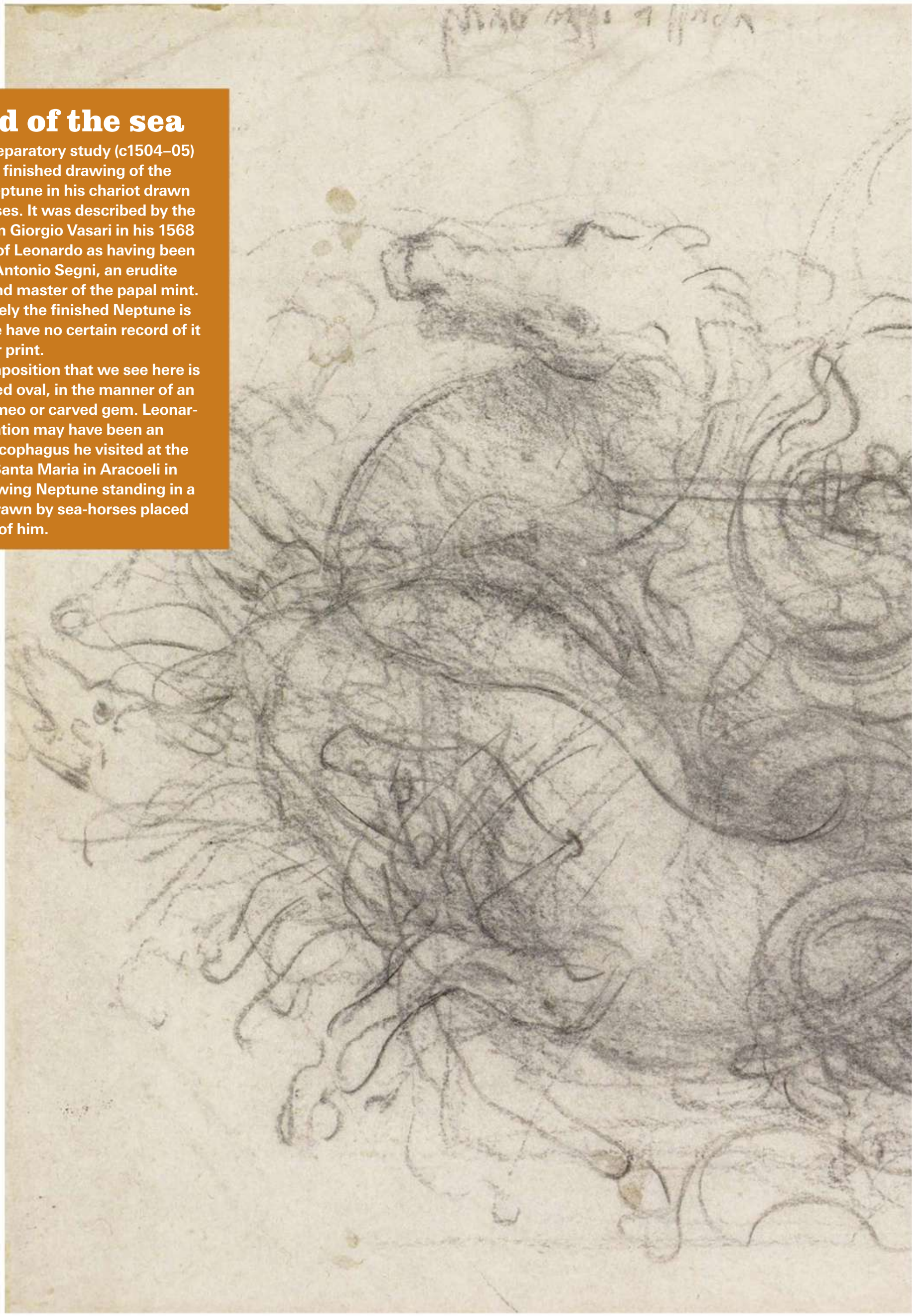
1 Ideal ugliness

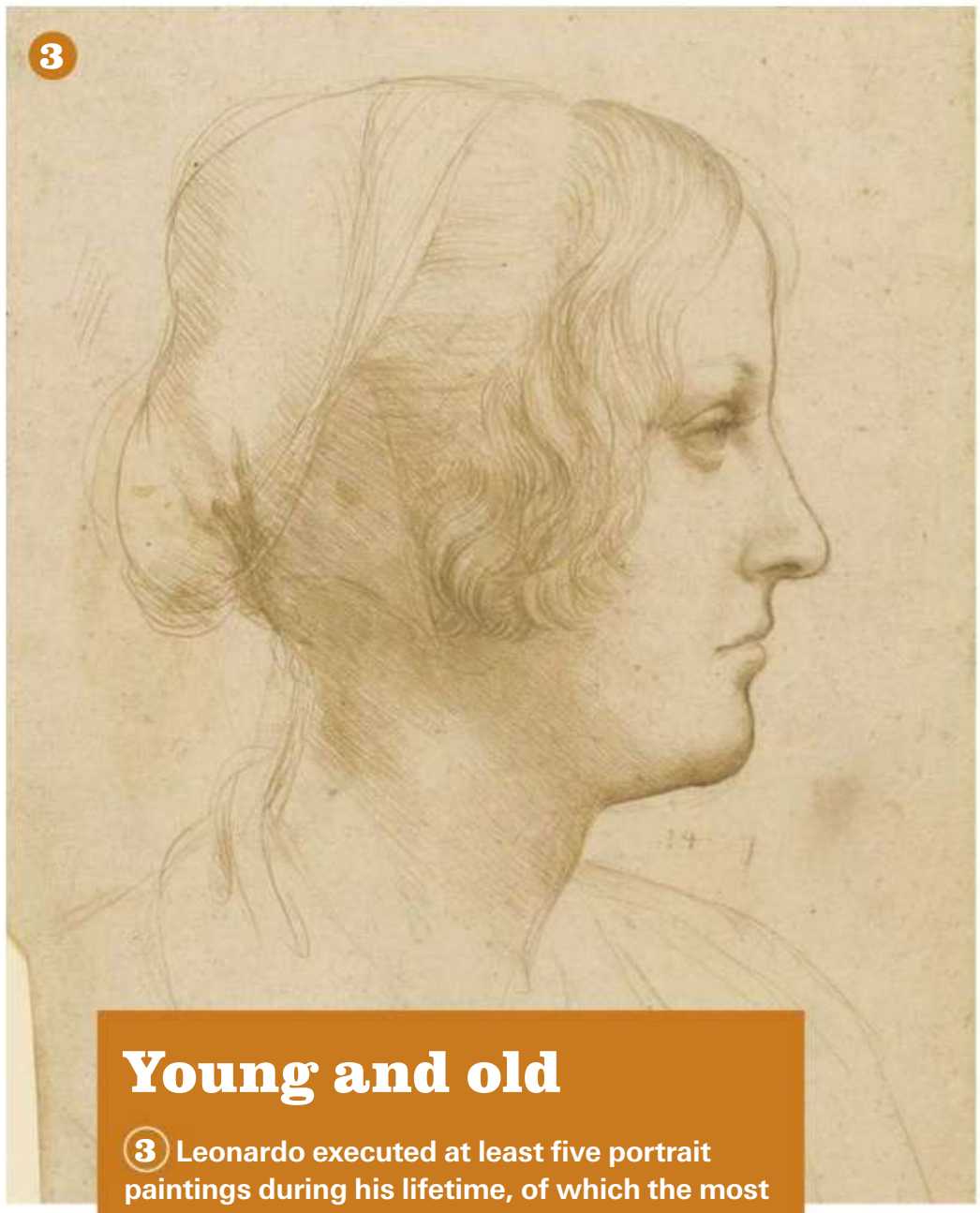
Throughout Leonardo's life, he sketched countless grotesque heads. They can be seen as a counterpart to his work on human proportion, distorting ideals of beauty to create images of 'ideal ugliness'. In this drawing (c1493), the man in the centre raises his right arm to have his palm read by an old woman in traditional Gypsy dress, while a figure on the left reaches under his sleeve to steal his purse. This was a period of particular hostility to Gypsies in Milan, and the drawing was therefore a satire on current affairs – probably made for the entertainment of the Sforza court.

② God of the sea

This is a preparatory study (c1504–05) for a highly finished drawing of the sea-god Neptune in his chariot drawn by sea-horses. It was described by the art historian Giorgio Vasari in his 1568 biography of Leonardo as having been drawn for Antonio Segni, an erudite collector and master of the papal mint. Unfortunately the finished Neptune is lost and we have no certain record of it in a copy or print.

The composition that we see here is an elongated oval, in the manner of an antique cameo or carved gem. Leonardo's inspiration may have been an ancient sarcophagus he visited at the church of Santa Maria in Aracoeli in Rome, showing Neptune standing in a low boat drawn by sea-horses placed either side of him.



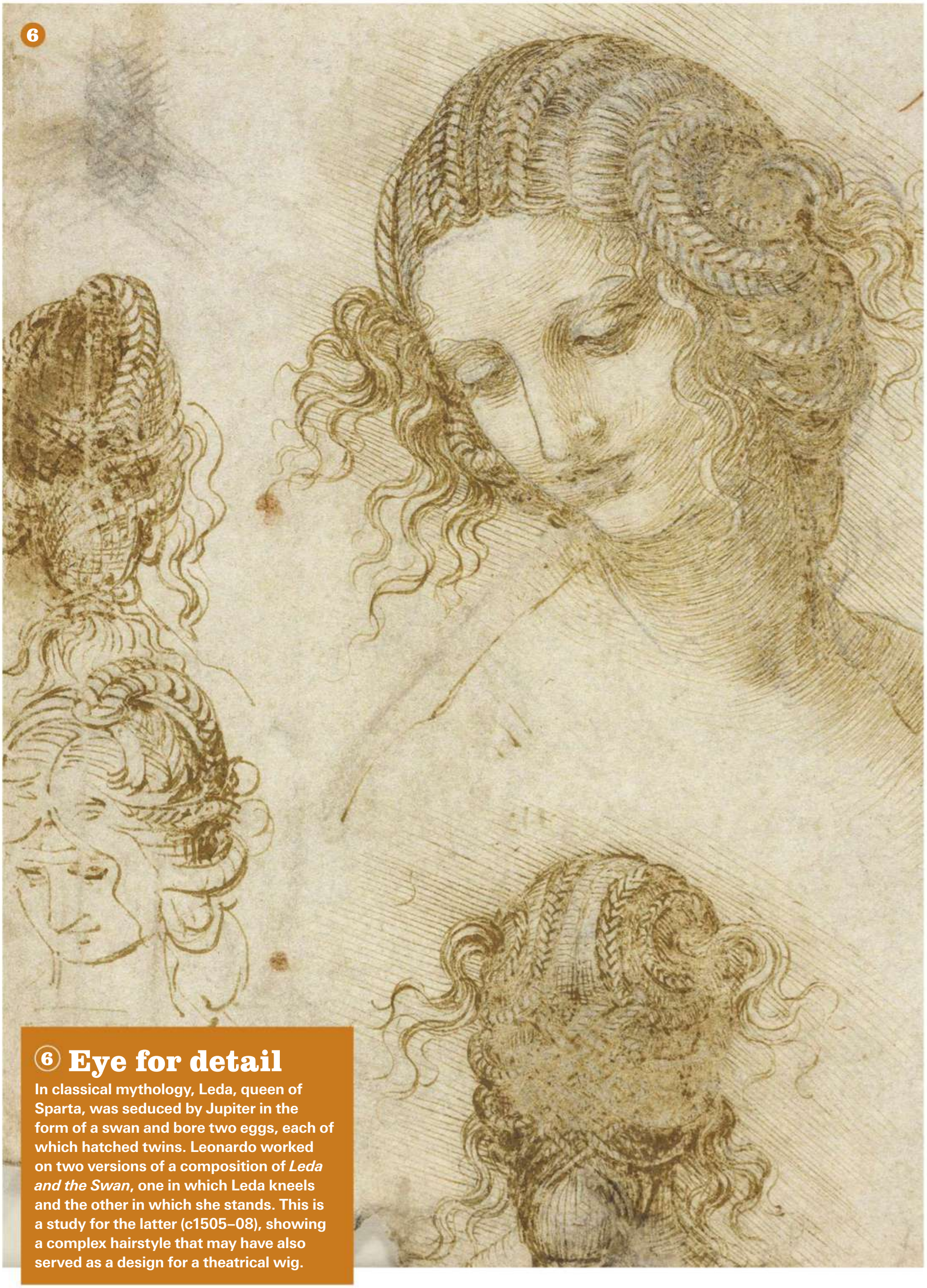


Young and old

3 Leonardo executed at least five portrait paintings during his lifetime, of which the most famous, the *Mona Lisa* (see page 59), is the least typical, for the sitter is so idealised that she has lost her individuality. This drawing (c1485–90), is wholly different – a rigorously observed study of a woman in everyday clothing, probably drawn not as preparation for a painting but as a finished work for Leonardo's own satisfaction.

4 Only from the end of Leonardo's life do we have a significant number of detailed costume drawings, which give some idea of the rich dress he must have devised throughout his career for a variety of different events. This example, dated c1517–18, shows a man dressed as a lansquenet (a German mercenary). Leonardo's patron, Francis I of France, had a taste for lavish entertainments, and this is the sort of costume a guest would have worn to a masquerade.

5 The hesitant chalk lines in this drawing of a withered old man suggest that it must have been created right at the end of Leonardo's life, as his physical powers began to fail him. While this is not a literal self-portrait, it must be regarded on a profound level as a self-image – an exploration of Leonardo's perception of himself, both noble and pathetic, as he approached death.



6 Eye for detail

In classical mythology, Leda, queen of Sparta, was seduced by Jupiter in the form of a swan and bore two eggs, each of which hatched twins. Leonardo worked on two versions of a composition of *Leda and the Swan*, one in which Leda kneels and the other in which she stands. This is a study for the latter (c1505–08), showing a complex hairstyle that may have also served as a design for a theatrical wig.

7 Animal inspiration

One of the most charming of all of Leonardo's drawings, this sheet (c1517–18) covers the full range of Leonardo's modes – from the most stylised and 'Leonardesque' in the coiling dragon, to the most acutely observed and unaffected in the adjacent studies of domestic cats.

The detailed studies at centre right show cats sleeping, and seem to have been done directly from life while the subject was motionless. By contrast, the depictions of cats fighting each other would have instead been visualised on the basis of fleeting impressions.

8 Out in the field

Leonardo drew plants and flowers throughout his life, following the tradition of naturalistic detail in 15th-century Italian art. A list of drawings in his possession in the early 1480s, for example, includes "many flowers portrayed from nature", which may have been preparatory for his first *Virgin of the Rocks* (see page 48).

The focus of this sheet, dated c1506–12, is a clump of star-of-Bethlehem, flanked by a wood anemone and with sun spurge below. Although the star-of-Bethlehem is somewhat stylised, the blades of grass growing among and behind the anemones suggest that Leonardo observed these plants in the wild.

Nature's fury

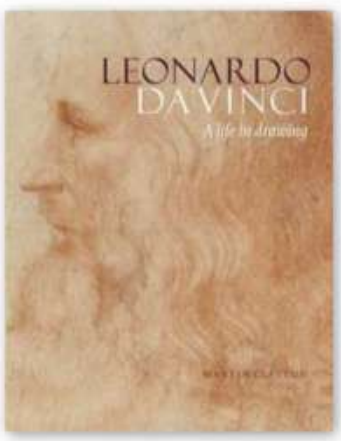
9 A cataclysmic storm overwhelming the earth was one of Leonardo's favourite subjects during the final years of his life, as demonstrated by this 'deluge' drawing (c1513–18). It is surely not fanciful to see this obsession with death and destruction as the personal expression of an artist nearing his end, who had seen some of his finest creations unfinished or destroyed before his eyes.

Supper sketches

10 Leonardo's greatest painting to reach completion was the *Last Supper* (see page 66), in the refectory of Santa Maria delle Grazie in Milan. This is the only true compositional study known for the mural, showing Christ and his disciples seated at the table. It's possible that the studies of arcading and octagons at the bottom of the sheet relate to building projects at Santa Maria delle Grazie.

11 The face of a genius

Both sides of this sheet contain studies by Leonardo for an equestrian monument he planned for Francis I. The sheet was also used by an assistant to sketch two heads – a smiling youth and a pensive old man with a full beard. Comparison with a formal portrait of Leonardo by his pupil Melzi, which must be close in date (c1517–18), suggests that this too is a depiction of Leonardo: the straight nose, the line of the beard rising diagonally up the cheek to the ear, a ringlet falling from the moustache at the corner of the mouth, and finally, the long hair falling from the back of the head. H



EXHIBITIONS

The text in this article has been adapted from the exhibition catalogue *Leonardo da Vinci: A Life in Drawing*, by Martin Clayton, head of prints and drawings, Royal Collection Trust.

To find out more about the exhibitions and to purchase a copy of the catalogue, visit *rct.uk/leonardo500*

Leonardo da Vinci: A Life in Drawing
The Queen's Gallery
Buckingham Palace, London
24 May – 13 October 2019

The Queen's Gallery
Palace of Holyroodhouse, Edinburgh
22 November 2019 – 15 March 2020

THE POLYMATH

GETTY IMAGES

Vivid depiction
One of the hundreds of detailed anatomical studies that Leonardo drew after dissecting cadavers

LEONARDO'S VISION OF THE HUMAN BODY

Domenico Laurenza reveals how Leonardo's fascination with the figure in art developed into a keen interest in anatomy, and how his dissections of human cadavers also informed his innovative studies of machines and geology

GETTY IMAGES

From artist to anatomist

Leonardo undertook and recorded, in stunning drawings, his detailed studies of the body in a new field – anatomy – that would later revolutionise medicine

Leonardo initially studied anatomy so he could represent the human body more accurately in his art, and the influence of such studies can be seen in his portrayal of figures in numerous paintings. However, he later became interested in anatomy for its own sake. His curiosity led him not just to attend demonstrations by medics, but to undertake dissections himself, tackling many subjects throughout his life despite the difficulties of obtaining cadavers legally.

Significantly, Leonardo also expanded his awareness by reading classical authors such as Aristotle and Galen. The latter was a physician of Ancient Greece whose flawed work formed the basis for teaching anatomy up to the 13th–14th centuries and beyond. In fact, it wasn't until after Leonardo's death that anatomy was fully established as a science, which is considered to have begun in 1543 with the publication of *De Humani Corporis Fabrica* (On the Fabric of the Human Body) by Andreas Vesalius. This Flemish physician accomplished something of a revolution, laying the foundations for the transition from humoral medicine (involving the balance of four humours) to organicistic medicine – treating the maladies of specific organs.

But crucial to Leonardo's world, and the links he made between anatomy, technology and nature, was his early training in the workshop of Andrea del Verrocchio, where bells, weapons, machines for performances, and many other artefacts were produced, as well as sophisticated paintings and sculptures. The vision of Leonardo's contemporaries was dominated by 'mimesis' – the attempt to imitate or reproduce nature and reality. In terms of the human body in art, this meant understanding the anatomical causes of its external forms. Leonardo's studies of the bones of the forearm, for example, improved his understanding of the complex motion of the hand, seen in several paintings, such as in the gesture of Mary in the first version of *Virgin of the Rocks,* 1483–86 (now in the Louvre, see page 48). In contrast, Leonardo's most famous drawing of the body, the *Vitruvian Man* (shown on page 79) is actually an exploration of the geometry of perfect proportions rather than a depiction of a real human figure.

Leonardo eventually went beyond artistic-anatomical studies to carrying out detailed medical investigations in their own right

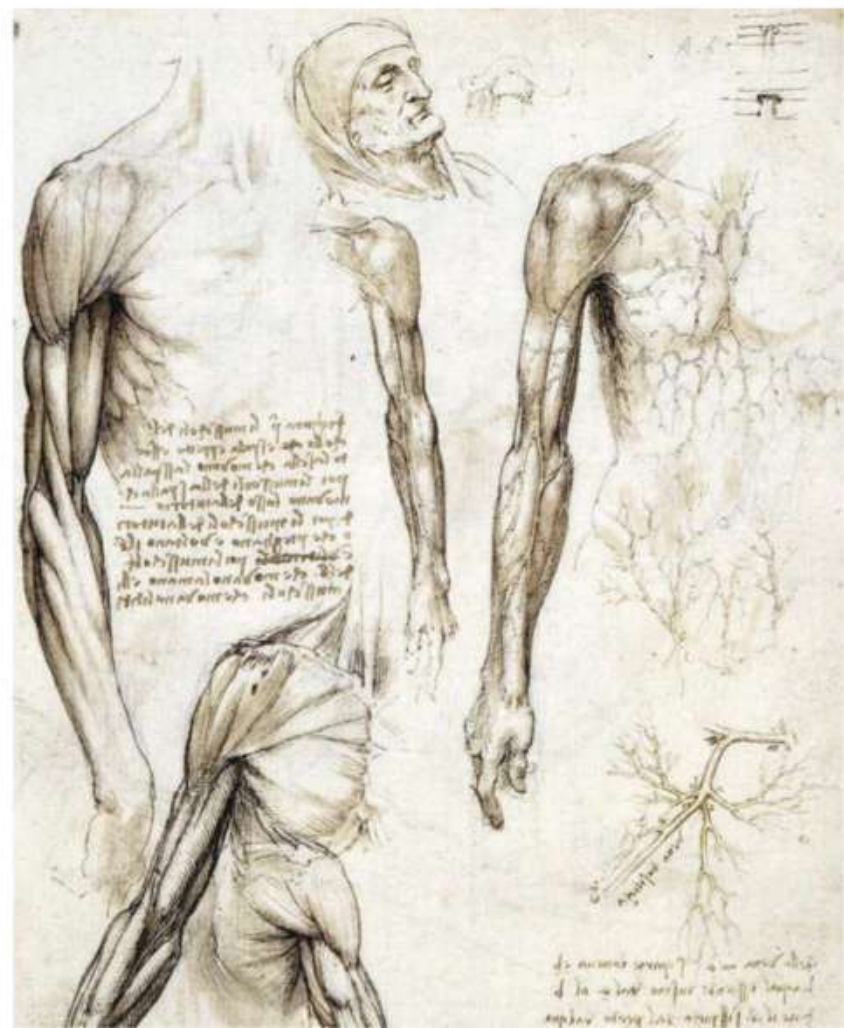
Medical breakthroughs

Leonardo eventually went beyond artistic-anatomical studies to carrying out detailed medical investigations in their own right. His first well-documented dissections of the body, the cadavers of an elderly man and a two-year-old child, date from the early 16th century. This resulted in his now-famous description of arteriosclerosis, comparing the man's crooked arteries with the straight ones of the child. Crucially, dissections undertaken during Leonardo's second Milanese period (1508–13) centred on three important areas: muscles and bones (explored in the so-called *Anatomy A*), embryology and the heart.

The last phase of Leonardo's anatomical research dates to his time in Rome between 1513 and 1516. Although he was reported to papal authorities (his dissections touched on controversial topics, such as the relationship between a mother's soul and that of her foetus), Leonardo made important discoveries.

Sophisticated drawings depict anatomical structures isolated in the course of dissection and remain masterpieces of analysis to this day. Others attempt more complex and comprehensive anatomical representations: exploded visions of the body; techniques of transparency; schematic images of the muscles as 'cords' to show their reciprocal positions; representations through juxtaposed sectors, which recall, at least in conceptual terms, our modern CAT scan visualisations of the human body.

A Flemish pioneer
Dissection demonstration in Padua by Andreas Vesalius (1514–64)

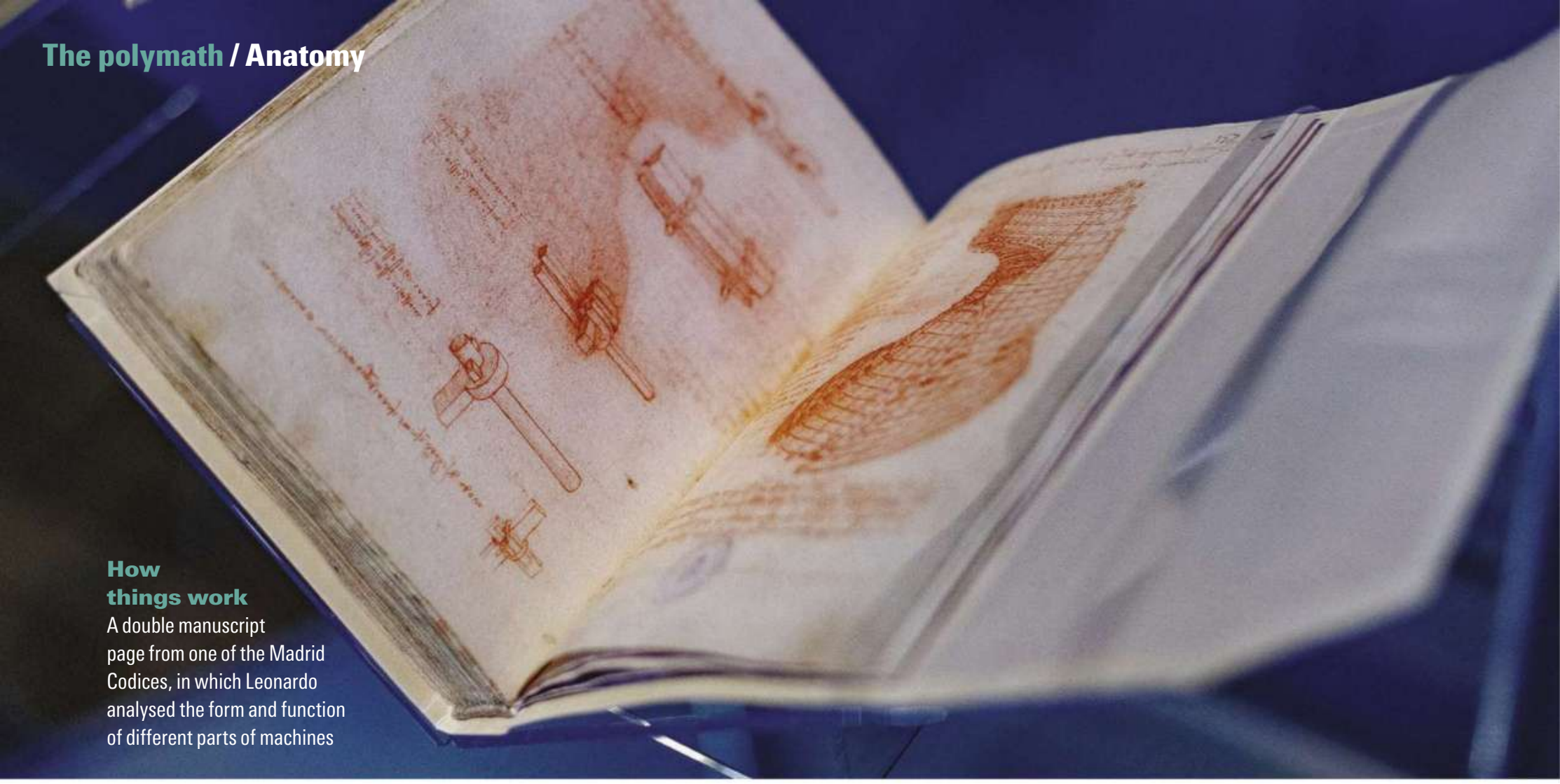


BELOW One of Leonardo's anatomical drawings, made c1510–11. Included with the scientific detail of the musculature of the shoulder is a touching portrait of the deceased

Birth of anatomy
A woodcut from Vesalius's 1543 treatise on anatomy, which is generally considered to mark the establishment of anatomy as a unique science

Study from nature
Leonardo's meticulous observations on the muscles of the shoulder and arms, as well as the bones of the foot, c1510–11, complete with his notes

BRIDGEMAN/GETTY IMAGES



How things work
A double manuscript page from one of the Madrid Codices, in which Leonardo analysed the form and function of different parts of machines

Comparing people and machines

Leonardo's work on the elements of machines became a model for his scientific study of human bodies and how they function

To fully appreciate Leonardo's studies on anatomy, it is necessary to turn to his work on machines. As an accomplished engineer as well as an artist, he began to develop an understanding of the human body in a mechanical sense, adopting it as a model for his scientific investigations.

Although many pages from Leonardo's notebooks survive, much material has been lost, including a book on the structure of machines, which he called the *Elementi macchinali* (elements of machines). Thankfully, however, similar content to this book is included in one of two codices discovered in Madrid in the 1960s. In this portion of material, Leonardo deconstructs or 'sections' machines down into basic components or mechanisms such as poles, levers, screws, pulleys, bearings, joints and hinges, before describing how each one functions.

On the whole, it is hard to say whether Leonardo's scientific-anatomical model influenced his work on machines or vice versa. What is certain, however, is that the *Elementi macchinali* often served as a paradigm for his anatomical explanations.

For example, in one important study found inside the *Codex Madrid I*, he describes what he calls the "universal pole", allowing movement in all directions, followed by the "two-movement pole", allowing movement in two different types of direction, and so forth. Later, he applied these ideas to anatomy, explaining how the shoulder allows the arm to perform a virtually unlimited number of movements, writing: "These motions could be called infinite, because if we place a shoulder against a wall, and trace a circular figure with its arm, then all the motions that exist will be carried out by that shoulder." This is all made possible, Leonardo suggests, by the unique shape of the shoulder joint, recalling exactly what he had previously described as the "universal pole".

However, to truly emphasise the connection between machines and the human body, Leonardo went as far as to describe specific mechanical devices with biological characteristics. In one set of drawings held in the Royal Collection at Windsor Castle, he compares the spine – kept stable by muscles and bones – to the mast of a ship supported by shrouds (the pieces of rigging that stabilise the mast from side to side), while in a separate study from the *Codex Arundel*, shown on the page opposite, Leonardo likens the heart and the lungs to the workings of a stove. Having drawn a stove-like device that allows hot air to exit and fresh air to enter via a series of valves and a window, the accompanying text next to the illustration describes the function of the lungs and trachea as being similar to that of a chimney, expelling hot air burned by the heart.

It is hard to say whether the scientific-anatomical model influenced Leonardo's work on machines or vice versa

Importantly, Leonardo also looked at the effects of friction, exploring a number of ideas that could reduce its impact on machines. However, in the case of the human body, Leonardo believed that friction could be seen as a positive force, such as in the case of blood, which he claimed was heated by a 'whirling' motion as it passed through the chambers of the heart.

In accordance with traditional beliefs, this so-called 'innate' or 'natural' heat was associated with the generation of spirits, which were thought to be responsible for the mysterious force of life present within the human body. Having discovered that the heart was a muscle, Leonardo sought to provide a mechanical and dynamic explanation for its function.

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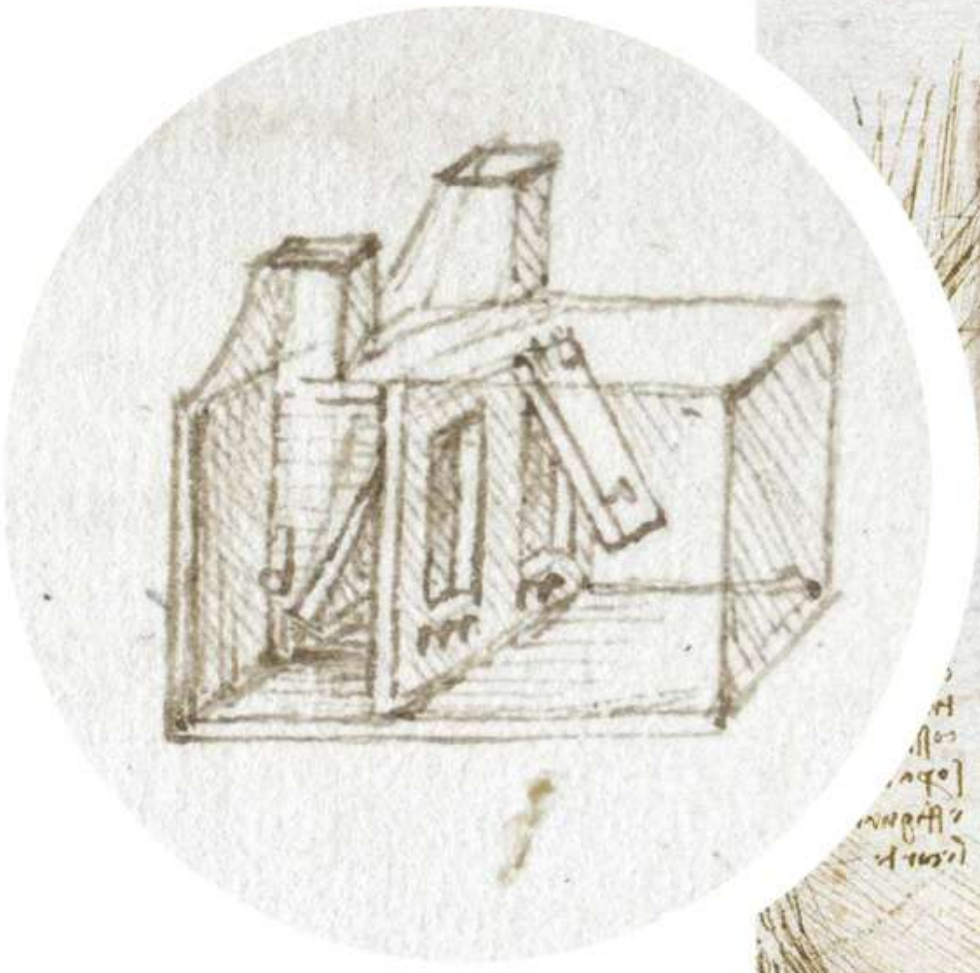
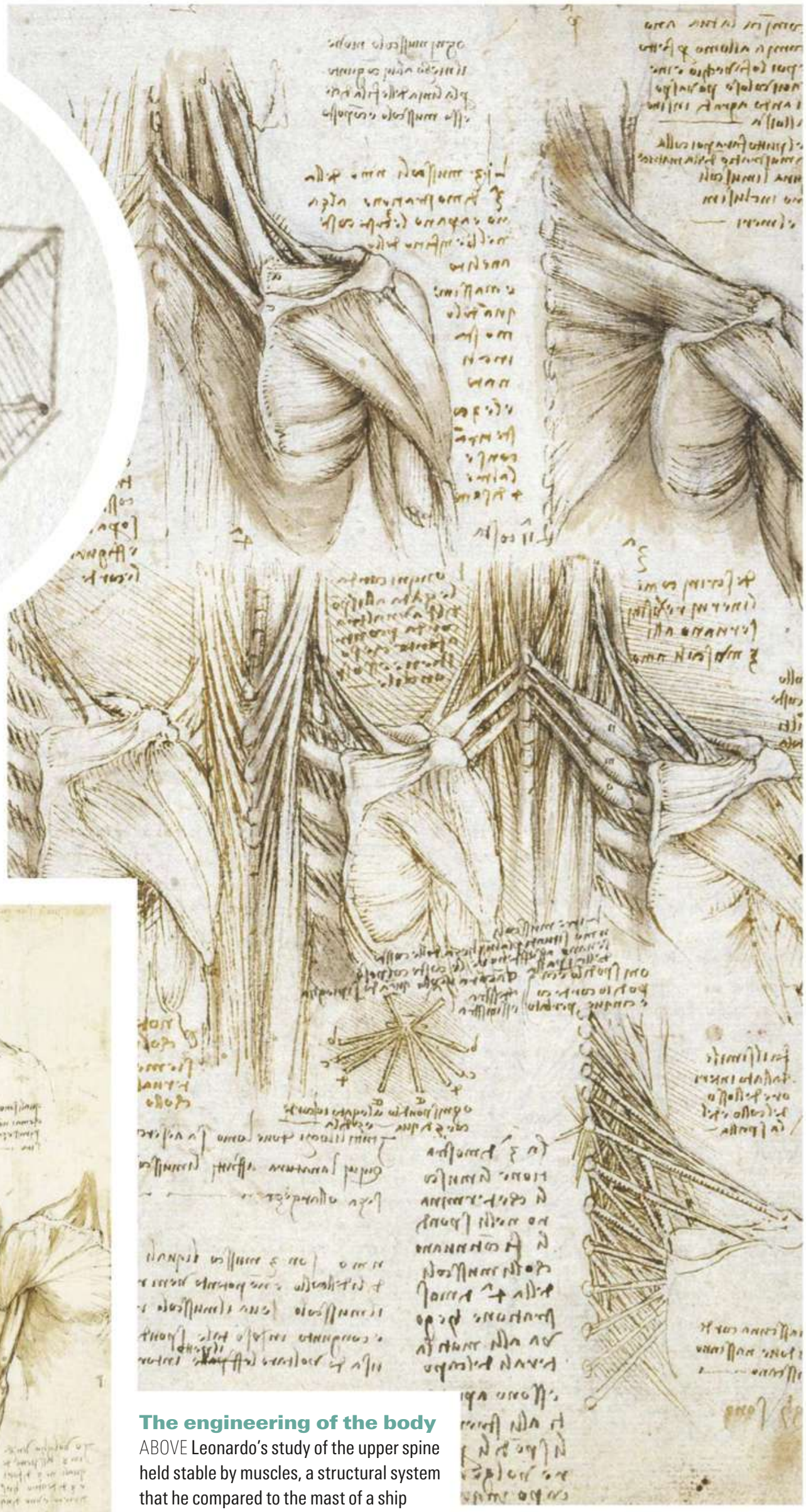


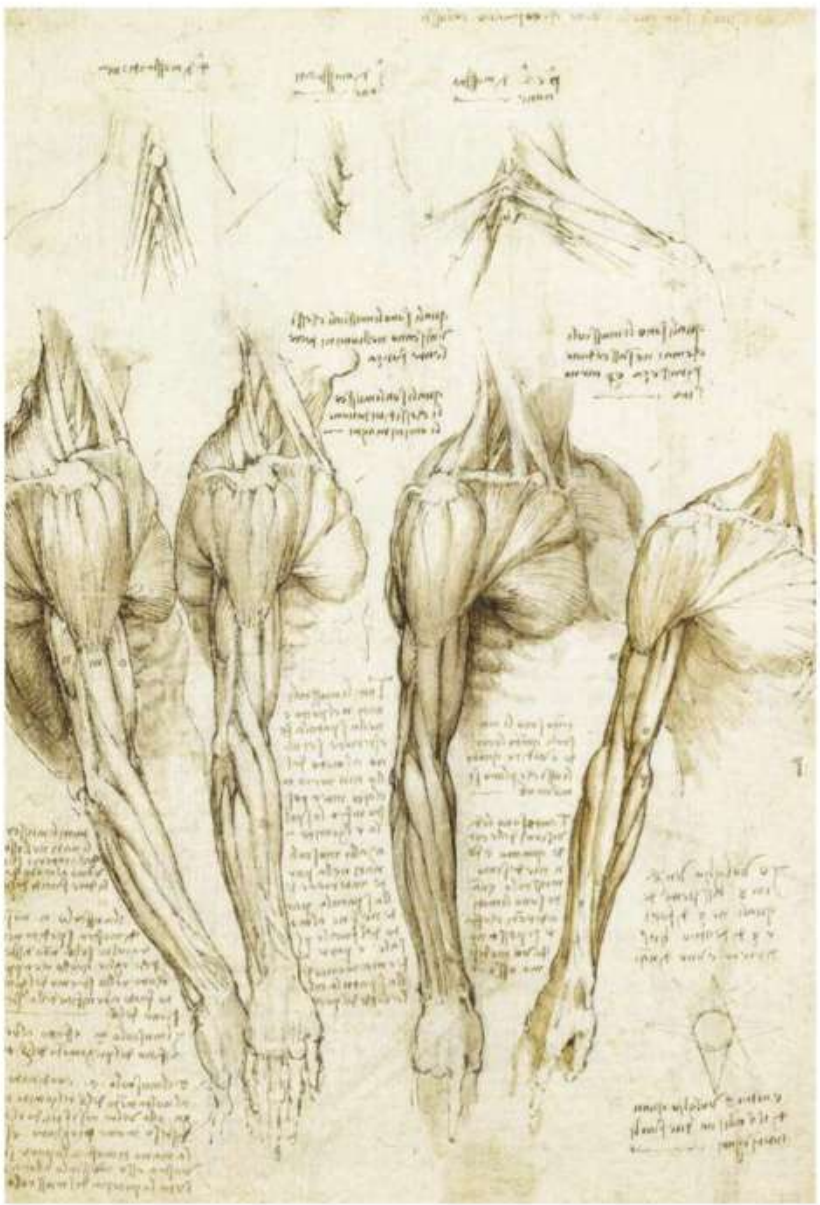
Full of hot air

Leonardo compared the heart-lung system to this stove that he drew. Notes below his drawing compare it to the human lungs and trachea which, working like a chimney, expel hot air burned by the heart



The engineering of the body

ABOVE Leonardo's study of the upper spine held stable by muscles, a structural system that he compared to the mast of a ship stabilised by rigging



LEFT Anatomical study of the shoulder, 1510–11. Leonardo studied joints of the body, and their dynamic functions, just as he had done with 'elements of machines'

BRIDGEMAN-BRITISH LIBRARY/GETTY IMAGES

Blood of the earth
Leonardo posited that water rose up through the earth via a network of subterranean channels – much like veins carrying blood through the body

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The human body and the natural world

Leonardo's fascination with geology, combined with his knowledge of anatomy, led him to see the earth as resembling a body with a beating heart like that of man

In the winter of 1513, Leonardo – by now an old man – put down on blue paper some of his most famous anatomical studies. At the time he was staying in a villa in Vaprio d'Adda, Lombardy, as a guest of his pupil Francesco Melzi, where he simultaneously studied the eddies of the river Adda and the currents of blood that he discovered by dissecting an ox heart.

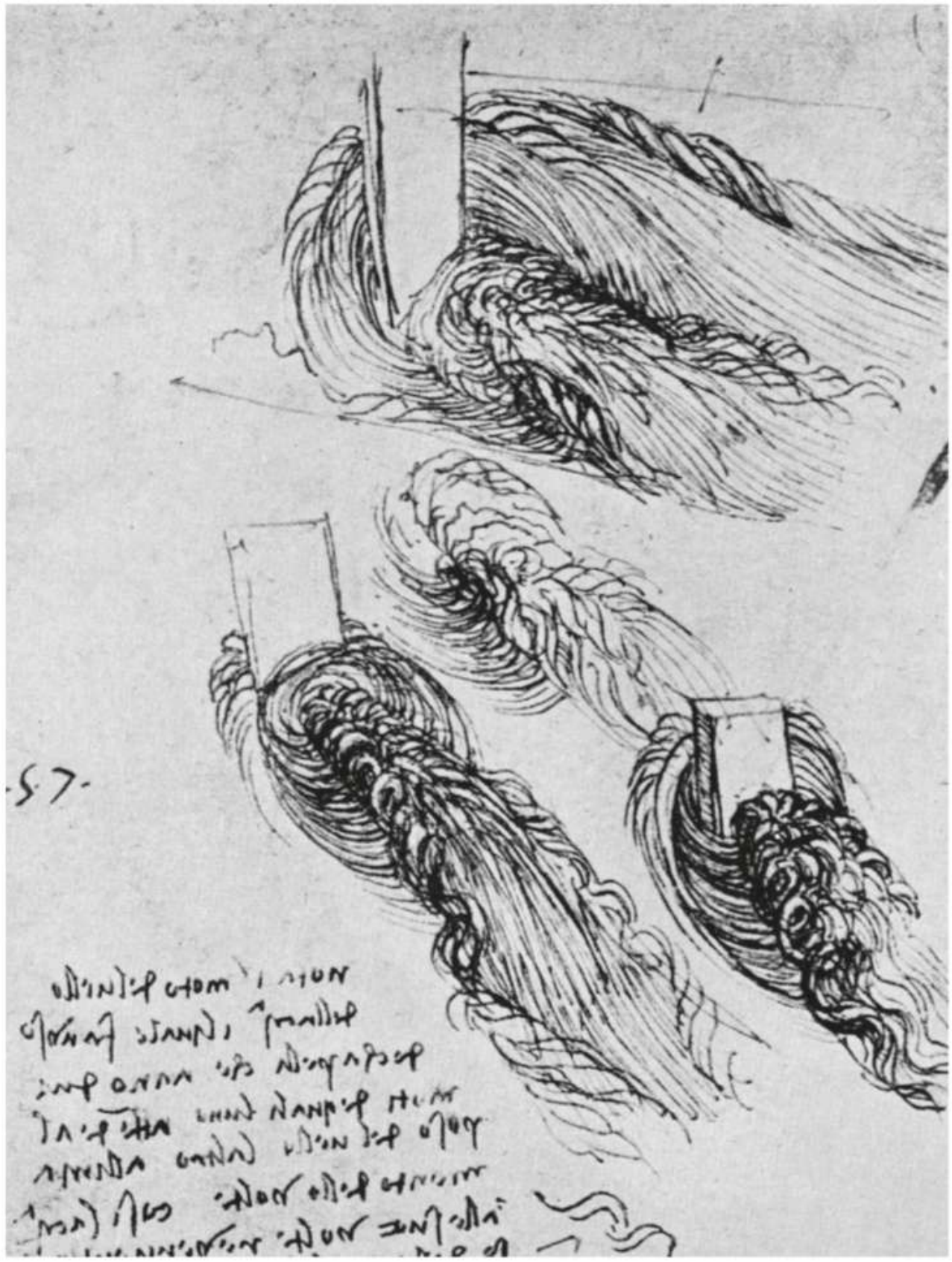
The similarities Leonardo observed between the two are now well-known, as are those he noticed between the vortices in water and the bending or curling of hair. In the latter case, he described how the impetus of water to descend towards its natural seat (the sea), when thwarted by an obstacle, generates a vortex; and also, how the tendency of hair to rise under the action of natural body heat, hampered by the weight of the hair, performs the same and creates curls. As Leonardo writes in one famous study, now held in the Royal Collection at Windsor Castle (pictured right):

"Observe the motion of the water's surface, which resembles that of hair, and has two motions, of which one is due to the weight of the hair, and the other forms the lines of eddies, and thus the water forms additional whirlpools, one part of which is due to the impetus of the main current, while the other is incidental and reflected motion."

The intertwining of the study of human and animal bodies (which he saw as microcosms), and the study of the earth's 'body' (regarded as a macrocosm), was to form the general framework of Leonardo's theories on anatomy and geology.

Understanding the earth as a body

Leonardo's link between the two different fields was often explicit, as in the case of his explanation of the water cycle and the presence of mountain springs, bubbling up from the earth. These phenomena seemed a contradiction of the laws of the elements, since water by nature must go down to the sea to reunite with its 'natural place'. Therefore, according to Leonardo, the earth was crisscrossed by underground channels carrying water. These were its veins, like those carrying blood in the human body; and just as blood is carried upwards to the head by 'innate heat', so water is carried upwards by heat within the earth's body to the mountains, from which it descends to start its cycle



The shape of water
Leonardo spent time studying the flow of water. As this drawing demonstrates, he noted that the patterns resembled human hair

The intertwining of the study of human and animal bodies, and the study of the earth's 'body', informed theories on anatomy and geology

GETTY IMAGES

Layers of history
Study of an outcrop of stratified rocks. Leonardo studied geology as part of his quest to understand the history of the earth

once more. This is not the only explanation that Leonardo gave for the water cycle, but it is the one that fascinated him for the longest – at least up until his composition of the *Codex Leicester*, around 1508, which contains an intriguing analogy between the earth and human physiology:

"So we might say that the earth has a vegetative soul, and that its flesh is the soil; its bones are the arrangements of the connections of the rocks which form the mountains; its cartilage is the tufa stone [a variety of limestone]; its blood the veins of its waters. The lake of the blood that lies around the heart is the ocean. Its breathing by the increase and decrease of the blood in its pulses is the ebb and flow of the sea. And the heat of the soul of the world is fire, which is spread throughout the earth; and the seat of the vegetative soul are the fires, which in divers parts of the earth are breathed out in baths and sulphur mines, and in Vulcanus and Mongibello [Mount Etna] in Sicily, and in many other places."

The notion of the 'soul' – regarded by Leonardo as the principle of life in both the human body and the body of the earth – is an aspect that roots Leonardo's studies firmly in the past, with some scholars citing it as a lapse of empiricism in his anatomical research, which is otherwise so factually based. However, Leonardo's fascination with the soul has been viewed as an influence on some of his artistic creations, and perhaps responsible for the remarkable visual harmony we see between figure and landscape in the *Mona Lisa* (see page 59). According to this line of thinking, the scenery in the background of the painting is regarded as a representation of the body of the earth, or macrocosm, corresponding to the portrait figure as a microcosm.

The notion of the 'soul' is an aspect that roots Leonardo's studies firmly in the past, with some scholars citing it as a lapse of empiricism in his anatomical research

A diverse chain of interests

To conclude this investigation, we should perhaps see Leonardo's work on anatomy as forming part of a chain. In the first part of this article, we have seen how Leonardo, as technician, artist and engineer, was so fascinated by anatomy that he turned himself into a scientist. We have then explored how the "elements of machines", to use Leonardo's own phrase, became a theoretical or scientific model for explaining the anatomy of bodies. Finally, we have also witnessed how his ideas on anatomy were used as a way of understanding geology and the complex structure of the earth.

From engineering to anatomy, from anatomy to geology, the different fields that Leonardo explored are linked together, but it is very difficult to see which came first and influenced the others. What we do know, however, is that his mind moved among these separate spheres of activity with a level of confidence that was unknown to contemporary science. H

Domenico Laurenza is a Leonardo scholar and a science historian. His books include *Leonardo: L'anatomia* (Giunti, 2009) and *Leonardo da Vinci: The Codex Leicester* (Giunti, 2018)

The bones of the earth
A rocky ravine. Leonardo drew an analogy between human physicality and the earth's body, describing rocks as the earth's bones and cartilage

GALLERY

The Virgin and Child with Saint Anne

Mary, her mother and child are arranged in a dynamic composition that shows both Christ's lineage and his destiny – the lamb symbolises his Passion, the final days before his crucifixion. Leonardo worked on this painting from the early 1500s.

ALAMY

GALLERY

Salvator Mundi

Leonardo's c1500 *Salvator Mundi* (Saviour of the World) was thought to be lost. Experts don't agree on whether this recently discovered painting is entirely by Leonardo's hand, but some say the orb is too skilfully painted to have been the work of anyone else.

ALAMY

LEONARDO ON FLIGHT

Domenico Laurenza explores the roots of Leonardo da Vinci's obsession with flight, and how the natural world – plus early experience of building theatrical props – inspired him to design fully-fledged flying machines

Dreams of flight
Leonardo hoped to launch a flight from Monte Cecero, near Florence. His notebooks are filled with wing designs, based on the anatomy of birds

MASTERING THE AIR LEONARDO'S VISION

Leonardo da Vinci's attempts to produce a flying machine rank among his most famous endeavours as an inventor.

In his *Codex on the Flight of Birds*, he inserted a note that encapsulated the ambitious, visionary nature of his project, hypothesising a flight taken from Monte Cecero, a hill close to Florence: "The large bird's first flight will be on the back of the great Cecero, filling the universe with awe, filling all the writings with its fame and with eternal glory the nest from where it was born."

However, to fully understand Leonardo's work on human flight, it is best to follow a chronological approach, beginning by looking at his early studies in Andrea del Verrocchio's workshop in Florence, through to the notes he made during the later years of his life in Milan, Rome and France.

Early in his career, Leonardo had already gone far beyond the scope of even the most ambitious engineers of his generation, envisioning real machines capable of making men fly – an idea centuries ahead of its time.

ALAMY/GETTY IMAGES

‘Flying’ props for the theatre

The young Leonardo was clearly fascinated by flight – but evidence suggests that his early machines were props intended for entertainment rather than being truly capable of travel

Leonardo’s earliest sketches of flying machines should be understood within the context of his apprenticeship to Andrea del Verrocchio in Renaissance Florence, where the young artist first honed his skills.

One of the most interesting drawings from this period can be found in the *Codex Atlanticus* 1, showing a machine with membrane-covered wings and a central form shaped like a boat’s hull. The device also sports a gigantic tail, along with a cable or screw passing centrally through the machine itself and extending both above and below, implying that it also served as a suspension cable – somewhat strange for a machine supposed to rise and fly.

The device’s purpose is cast into further doubt when turning to another set of drawings, long considered by experts as Leonardo’s earliest study for a flying machine. In a sketch depicting a figure with bat wings, there are also two triangular structures, converging at the top and bottom with what appear to be cables or suspension mechanisms. Elsewhere on the same sheet is a larger wing, connected to a hand-crank. Glancing at the device, it’s clear that the resulting alternating movement would not have been capable of producing sufficient flapping action for the wing to lift it off the ground.

In fact, it appears that Leonardo never actually planned to send these early machines into unassisted flight, and that the sketches instead depict elaborate props for the theatre. This was not necessarily unusual in 15th-century Italy, with artists’ workshops often responsible for the construction of sets and scenery used in theatrical performances, both of a religious and profane nature. Indeed, Leonardo had conceived several other devices intended for entertainment, including a preparatory drawing for a jousting banner and studies for a machine that would be capable of “generating a big voice”.

However, Leonardo’s early flying machine designs soon superseded those typically found in most artists’ workshops. Not only were they more complex, but they were also inextricably linked to his intense and prolonged investigations into the animal world. For example, on the back of the first flying machine study mentioned above, Leonardo writes: “This is the manner in which birds descend,” before outlining the path that birds would then follow.

Meanwhile, another page from the *Codex Atlanticus* includes studies for both a flying machine and a zoological examination of a dragonfly 4.

Together, the designs offer the first hint of what would later become the hallmark of Leonardo’s studies on flight: the remaking of nature, through which – using artificial means – he would replicate the features of natural flight gleaned from his observations of the natural world.

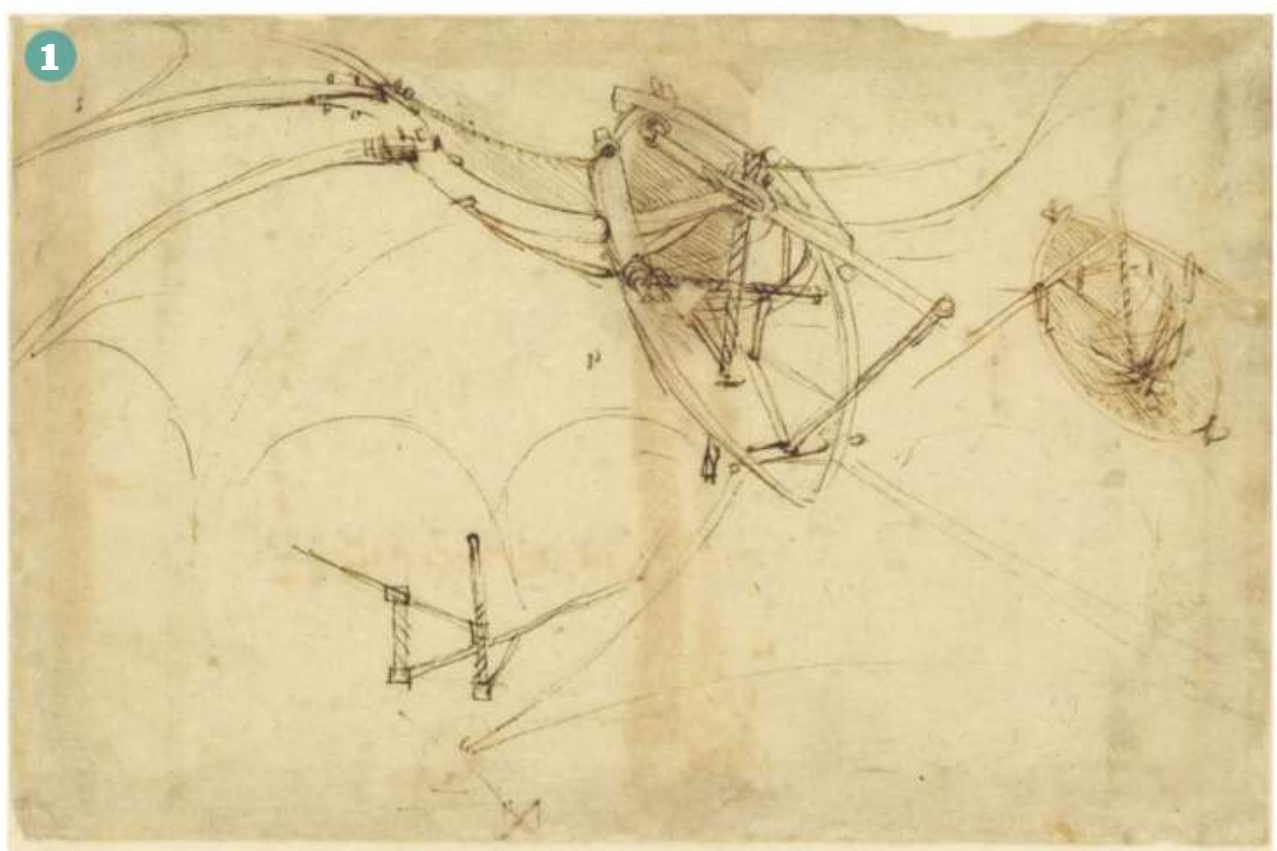
In these early projects, Leonardo did not mean to send his devices into unassisted flight: these were projects for the theatre

1 From sea to sky
Design for a boat-shaped flying machine from the *Codex Atlanticus*, probably for a theatrical production

2 All the world’s a stage
Leonardo designed props for theatres, which in this period evolved from wooden structures to elaborate masonry ones such as this Teatro Olimpico, Vicenza, c1580–85.

3 Dramatic appearance
Renaissance staging could involve elaborate flying props. Here Apollo descends from the clouds in a 1589 event hosted by the Medici

4 Insect inspiration
More sketches from the *Codex Atlanticus*, showing a wing-flapping device, modelled around anatomical studies of a dragonfly



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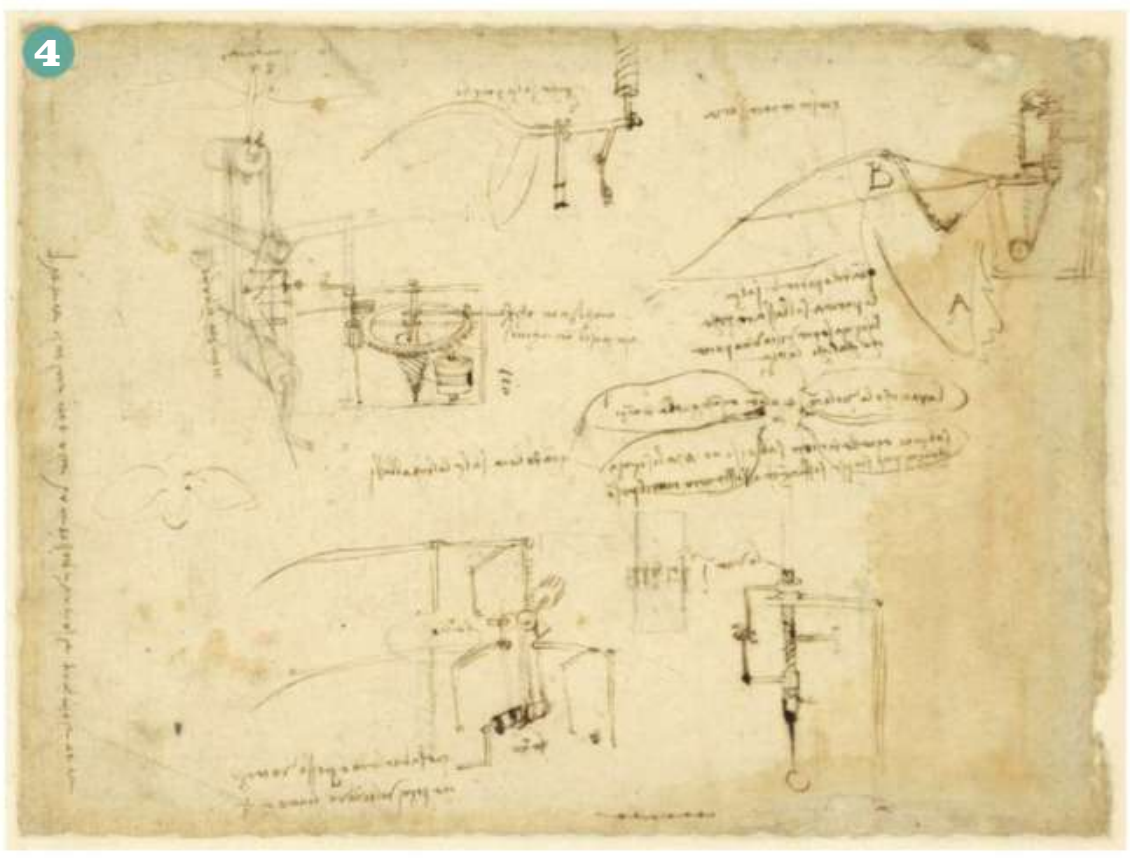
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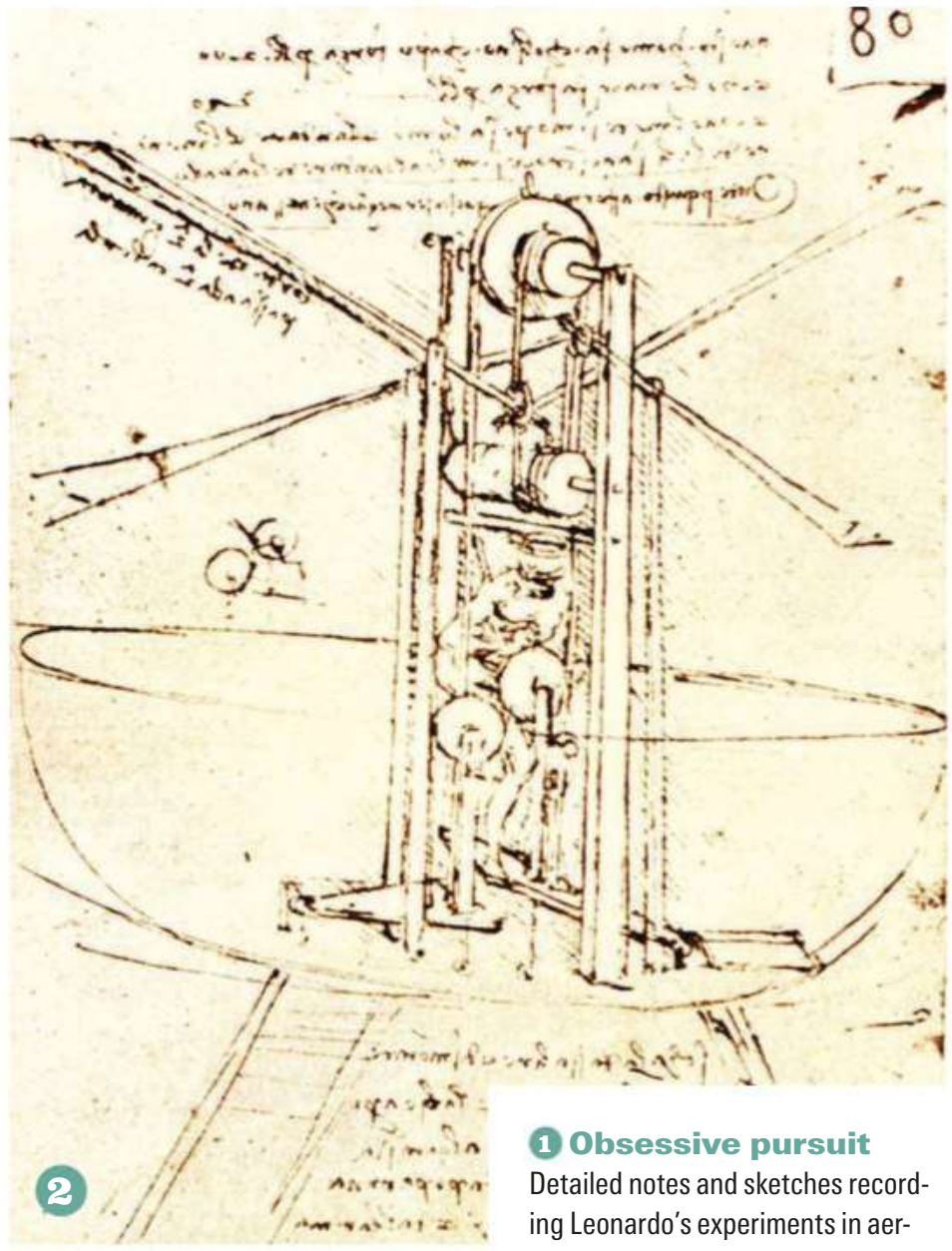


1 Obsessive pursuit
Detailed notes and sketches recording Leonardo's experiments in aerodynamics in the *Codex Atlanticus*. All of his notes are in mirror writing (running right to left)

2 Human powered
Diagram of a flying machine, with the four wings designed to be driven by the muscle power of the pilot, who stands in a central gondola

3 A wing and a prayer
More of Leonardo's wing designs from the *Codex Atlanticus.* These are designed to be strapped directly on to the human body

4 Spinning into takeoff
Design for a flying machine, whose mechanism modern observers have compared to a helicopter

BRIDGEMAN-BIBLIOTECA AMBROSIANA-MONDADORI/GETTY IMAGES

Creating contraptions to help man fly

After moving to Milan, Leonardo focused his energies on producing a machine capable of both achieving and maintaining flight, experimenting with designs relying on the dynamics of the human body

In a small drawing in the *Codex Atlanticus* Leonardo depicts a flying machine hanging from the ceiling of his workshop in Milan, where he had relocated by 1483.

By now, Leonardo's flying machines were intended to be the real deal – not just for theatre – and he knew they would have to be protected from prying eyes. His studio was located not far from Milan's grand cathedral, where at the time the construction of a *tiburio* (a type of domed tower) was well underway. The area was frequented not only by workers, but also by rival engineers, who could have spied the flying machine from the scaffolding. At a time when the concept of copyright did not yet exist, this was obviously a great source of worry for Leonardo.

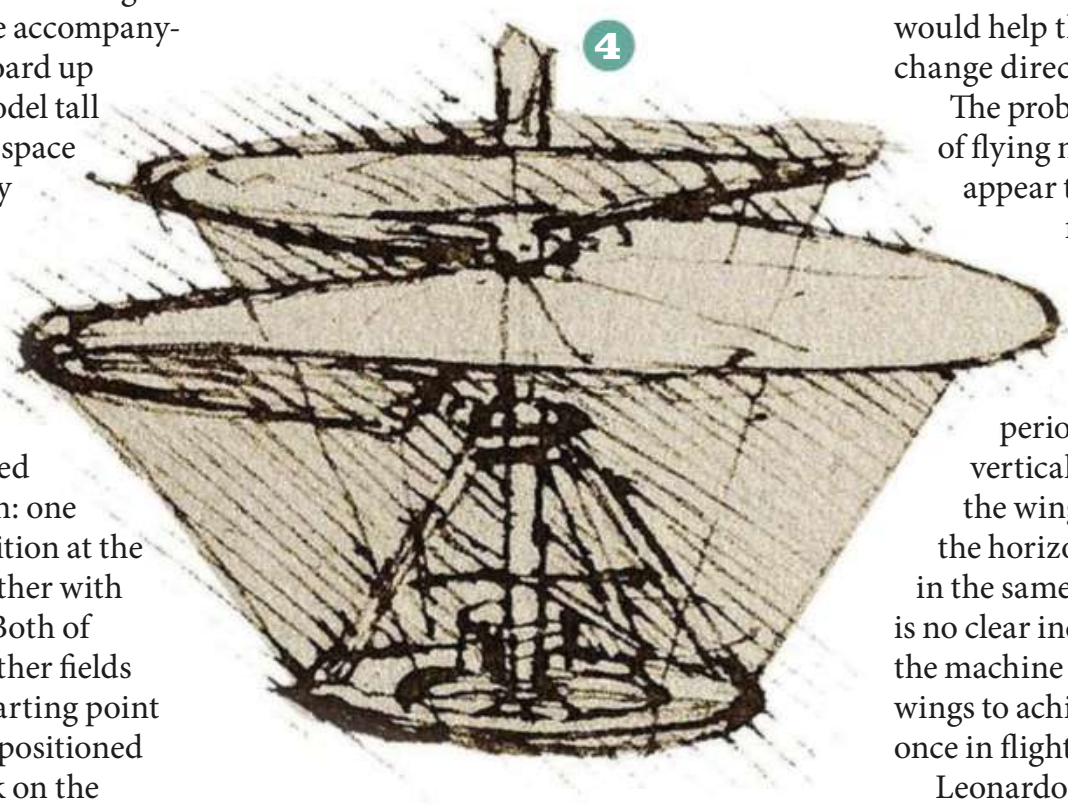
He planned, therefore, to conceal his prototype invention from those working on the cathedral roof. In a note accompanying the drawing, he writes: "Board up the top room and make the model tall and large, and there is enough space on the roof; it's higher than any other place in Italy. And if you stay on the roof alongside the tower, they can't see you from the tiburio."

The flying machines that Leonardo was so keen to keep under wraps generally consisted of two different types of design: one with the pilot in a vertical position at the centre of the device, and the other with the pilot placed horizontally. Both of these ideas sprang from two other fields of Leonardo's research. The starting point of his first idea (with the pilot positioned vertically) was tied to his work on the dynamics of the human body and the generation of movement.

In one drawing, depicting a man on a scale (*Codex Atlanticus*, 1), Leonardo attempted to demonstrate the different forces that a human was capable of producing, and how these could be increased using specific movements and positions of the body. These findings were then applied to experiments that sought to find out whether a human could make a mechanical wing flap up and down fast enough in order to achieve flight.

Another famous project, the so-called 'helicopter' (*Manuscript B*, 4), was based on the idea that air has a material density that can be "bored" into, and therefore a machine in the form of a screw with the right amount of speed ("quickly turned" by four men) can propel upwards.

But the machine that was most greatly inspired by Leonardo's studies of the human body was his "flying ship" (*Manuscript B*, 2). In this design, a pilot is shown standing in the centre of the machine, which is shaped like a semi-spherical vessel. As well as generating force using his feet and hands (via a system of pedals and cranks), the pilot is also supposed to produce force using his head. When combined, these forces then operate a complex mechanism to power the wings. In practice, however, this sketch again appears to have been more a visualisation of the forces that can be produced by the human body rather than a 'real' machine capable of flight.



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The so-called 'helicopter' is based on the idea that a machine in the form of a screw, turned with the right amount of speed, can propel upwards

In contrast, most of the studies regarding Leonardo's second type of machine (in which the pilot lies horizontally) deal with how a pilot could maintain flight and navigate once already airborne. In some drawings, the pilot's movements are limited to making the wings simply flap up and down, while in others, the wings are specially designed so that the edges are angled upwards during each 'upstroke', enabling them to cut into the air more easily. In the case of the latter, the wings are also articulated so they can be folded or spread – movements that would help the pilot maintain balance and change direction.

The problem with these two main types of flying machine is that there doesn't appear to have been any synthesis, as far as we know, between the concepts. Only a sheet in the *Codex Atlanticus* contains a more complete drawing of a flying machine from this period, in which the pilot stands vertically as in the "flying ship", while the wings are similar to those seen in the horizontal designs found elsewhere in the same codex. Again, however, there is no clear indication that the occupant of the machine could have actually moved the wings to achieve both take-off and balance once in flight.

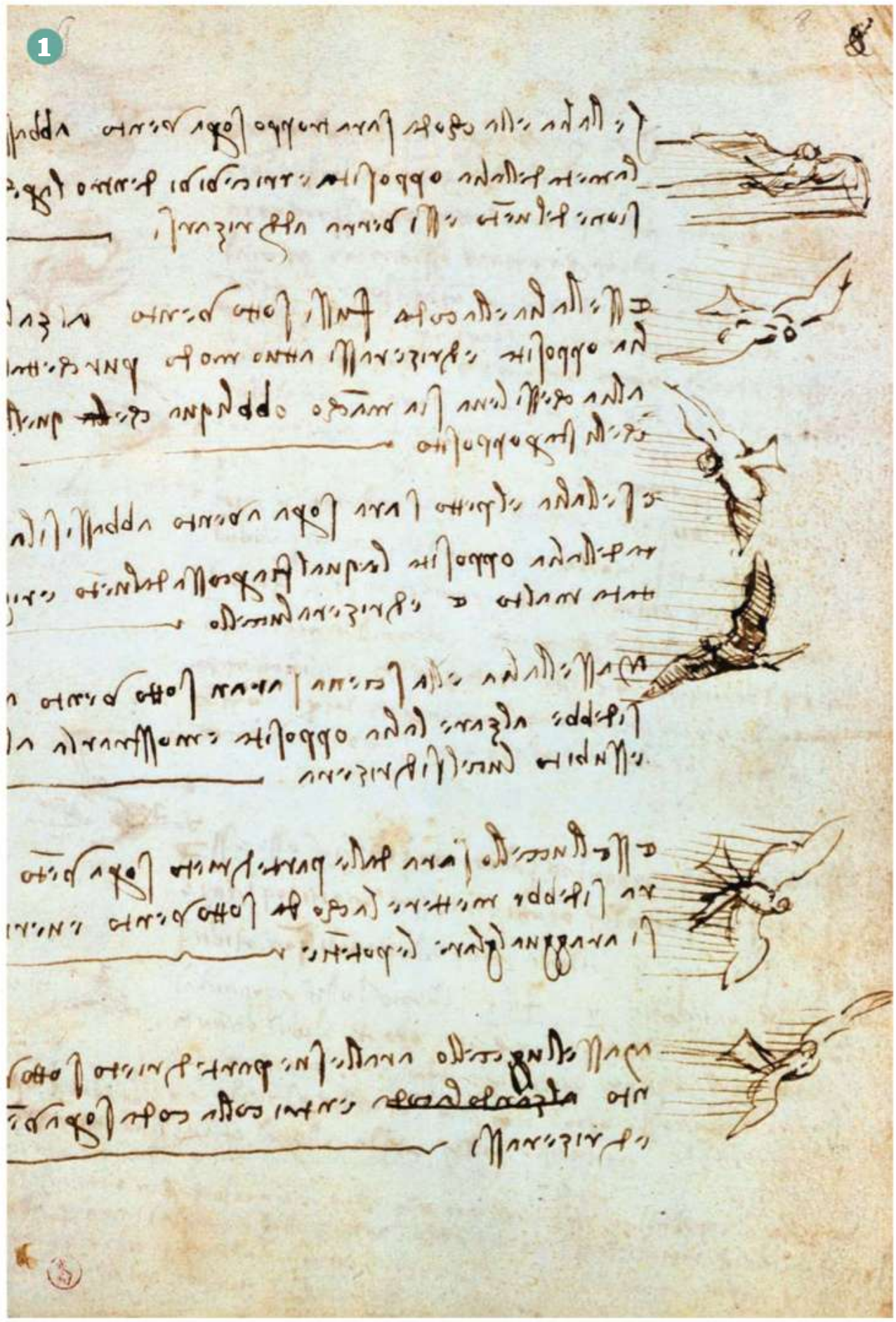
Leonardo also explored the concept of 'passive' flight or 'sailplaning' while he was working in Milan. He made a study of how winged seeds are carried along by currents of wind, as well as designing what could perhaps be described as an early type of parachute (*Codex Atlanticus* 1).

Two similar projects are found in the *Codex Madrid I*: the upper part of one page imagines a man in the middle of a 'flying sphere', surrounded by a fan, while the lower section includes a depiction of a kite from which a pilot could hang – much like a modern-day glider.

GETTY IMAGES

Studying the flight of birds

Upon returning to Florence at the turn of the 16th century, Leonardo's approach to flight was dominated by an ethos present in much of his work: uncover nature's secrets and imitate them as an engineer



Leonardo left Milan in 1499, and in 1500 he returned to Florence after almost 20 years away. There, he kept up work on his flying machine designs.

Studies of natural flight dominate Leonardo's writings during this era, with a close connection between his exploration of the anatomy of birds on the one hand and his designs for a flying machine on the other. In many regards, creating a device capable of making a man fly like a bird was representative of a more general set of beliefs that emphasised man's animal qualities – both in a positive and negative sense.

For instance, it was during this second Florentine period that Leonardo worked on a painting depicting the 1440 battle of Anghiari (see page 52), intended to decorate one of the halls of the Palazzo Vecchio. Believing that men and animals are dominated by emotional and furious parts of their soul during times of conflict, the painting was supposed to be a metaphor for war as "bestial madness", capable of turning man into beast. On the whole, the perceived sensitivity to animal subjects that has been attributed to Leonardo by some biographers (reinforced by the fact he was perhaps a vegetarian), suggest that he saw a fundamental continuity between humans and animals.

Crucially, however, this was the era in which Leonardo compiled the short *Codex on the Flight of Birds*, with the hills surrounding Florence, near the town of Fiesole, being among his favourite places to study these natural masters of the air. As Leonardo writes:

"When the bird has a great wingspan and a short tail, and wants to rise, then it will raise its wings forcefully, and turning will receive the wind under its wings, from which the wind, forming a cone, will powerfully thrust it upward, like the cortone, the bird of prey that I saw while going to Fiesole..."

Studies of natural flight dominate Leonardo's writings, and there is a close connection between his exploration of the anatomy of birds, and his designs for a flying machine

The *Codex on the Flight of Birds* contains several important ideas, beginning by explaining how birds can rise from the ground and stay in flight by flapping their wings. These pages are followed by sheets of technological studies in which Leonardo conceives of a flying machine that can mimic the flight of birds through man's muscular strength. Other pages are devoted to the equilibrium manoeuvres used by birds

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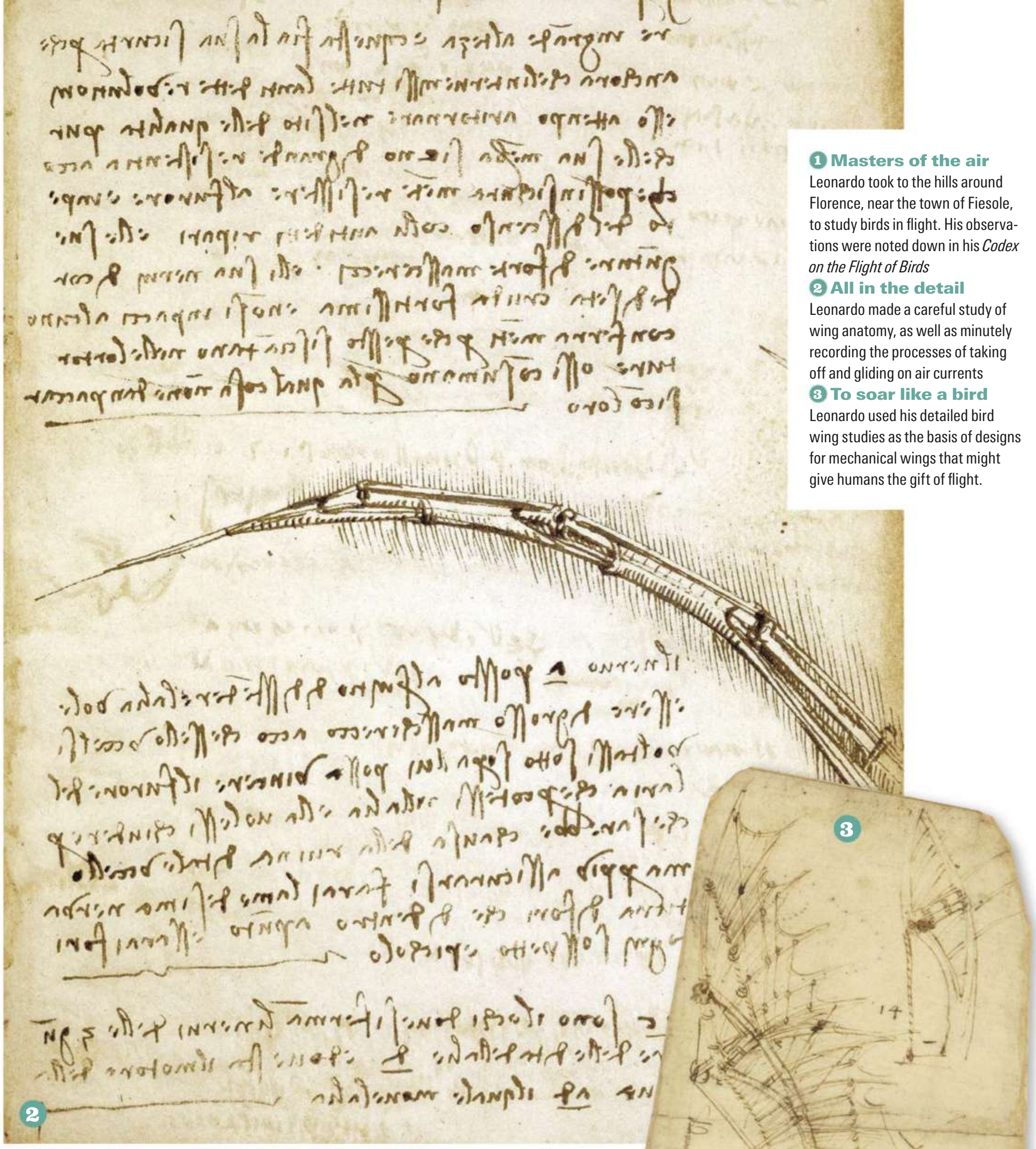

1 Masters of the air
Leonardo took to the hills around Florence, near the town of Fiesole, to study birds in flight. His observations were noted down in his *Codex on the Flight of Birds*

2 All in the detail
Leonardo made a careful study of wing anatomy, as well as minutely recording the processes of taking off and gliding on air currents

3 To soar like a bird
Leonardo used his detailed bird wing studies as the basis of designs for mechanical wings that might give humans the gift of flight.

for soaring in the wind, which are in turn succeeded by a number of sketches for mechanical wings that closely mimic the birds' natural capabilities.

Included within these sketches of Leonardo's are wings that are specifically intended for a flying machine, which, although artificial, have structures closely resembling the bone fragments present in natural wings. A similar sketch appears in the *Codex Atlanticus*, in which it is difficult to say whether it depicts an anatomical study of a natural wing or a project for a machine intended to imitate them.

Finally, the *Codex on the Flight of Birds* includes a section on 'statics' – the branch of mechanics concerned with forces in equilibrium – addressing the problems of balance when applied to human and artificial flight.

Although intended to be the concluding part of his investigation, this actually appears at the beginning of the codex. Like other works, Leonardo – who famously wrote from right and left using his 'mirror-writing' – presented his findings in reverse order.

Unfulfilled flying ambitions

Leonardo's fascination with taking to the skies never truly ended, but the prospect of building a working flying machine was to remain out of reach

Although Leonardo never quite abandoned the idea of human flight, he spent most of his later years – living in Milan, Rome and France – immersing himself in theoretical studies of air, water and the elements.

For example, one sketch shows two birds in a composition with wind and waves near a cliff (*Manuscript E,* 1). However, the main focus of the study is not the flight of the birds, but the study of the wind currents (invisible phenomena), realised by watching the animals' flight paths. It was during this same period that Leonardo produced another study, showing how the flight of birds themselves can change according to wind direction. (*Manuscript E,* 2 and 3).

Unfortunately, very few notes for flying machines date from the later years of Leonardo's life. Instead, we find sketches such as that of a flying automaton in the form of a bird, or a drawing of a man with wings attached to the shoulders, both harking back to the theatrical subjects that the ageing visionary had produced in his youth.

Ultimately, Leonardo's most important investigations into flight had come during earlier phases of his career, when he had the aim of putting a human being into the skies – arguably the most extreme example of his ambition to remake nature. The lack of lightweight materials, however, made it impossible for Leonardo to achieve his goals. His flying machine remained a technological dream.

While Leonardo's vision of human flight anticipated modernity in a remarkable way, it differs quite drastically from the course that aviation ultimately took. What he had in mind – namely, an imitative machine of natural flight – ended up being quite far removed from the modern aeroplane. H

What Leonardo had in mind – namely, an imitative machine of natural flight – ended up being quite far removed from the modern aeroplane

1 Gliding on the wind
In later years, Leonardo became less preoccupied with devising a working flying machine to take humans into the sky, and more fascinated by the invisible force of the wind and how this could determine the flight path of birds

2 & 3 Invisible currents
His later notebooks show diagrams of wind currents and how birds would be lifted on the air beneath their wings. He seems, by this point, to have given up on his ambition of human flight

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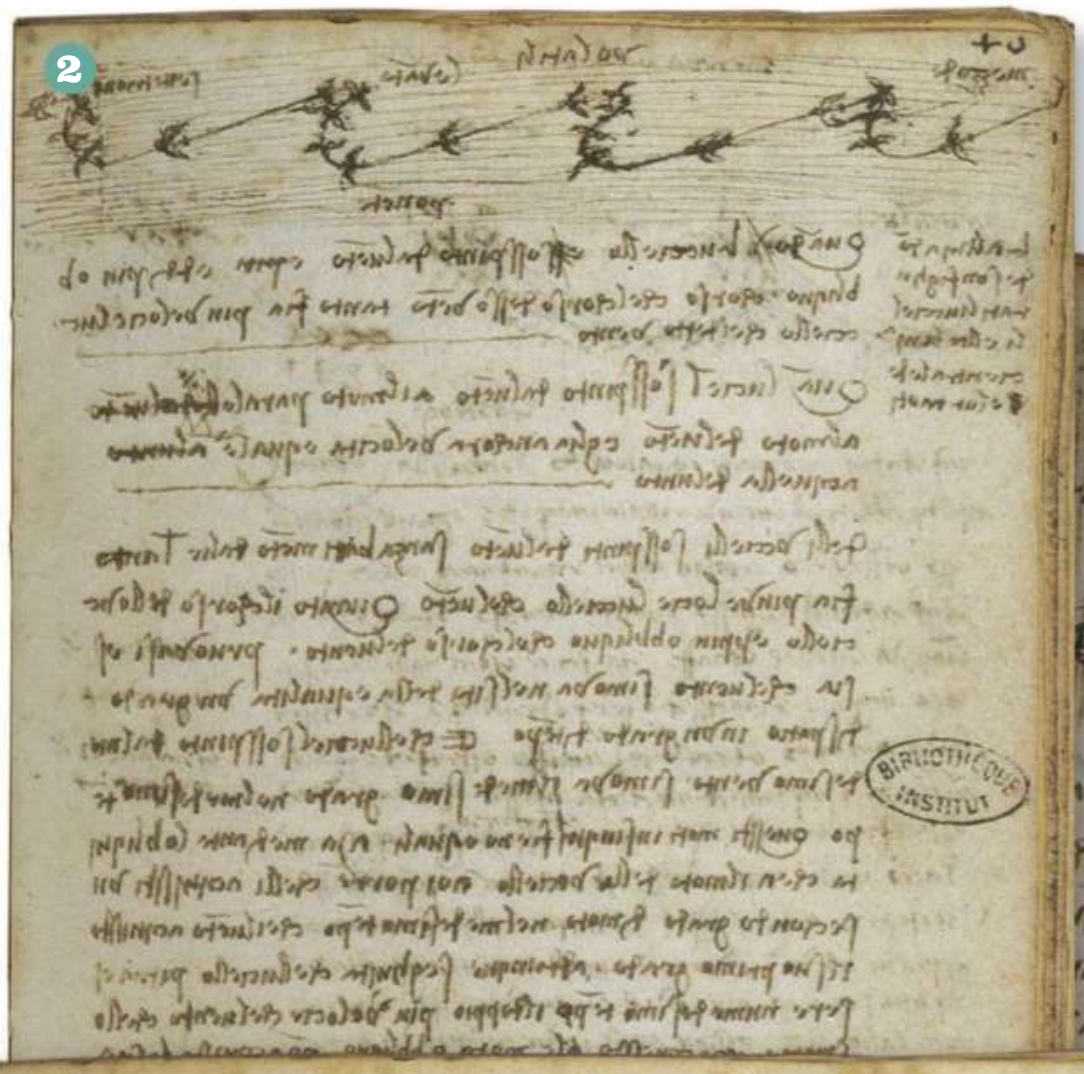

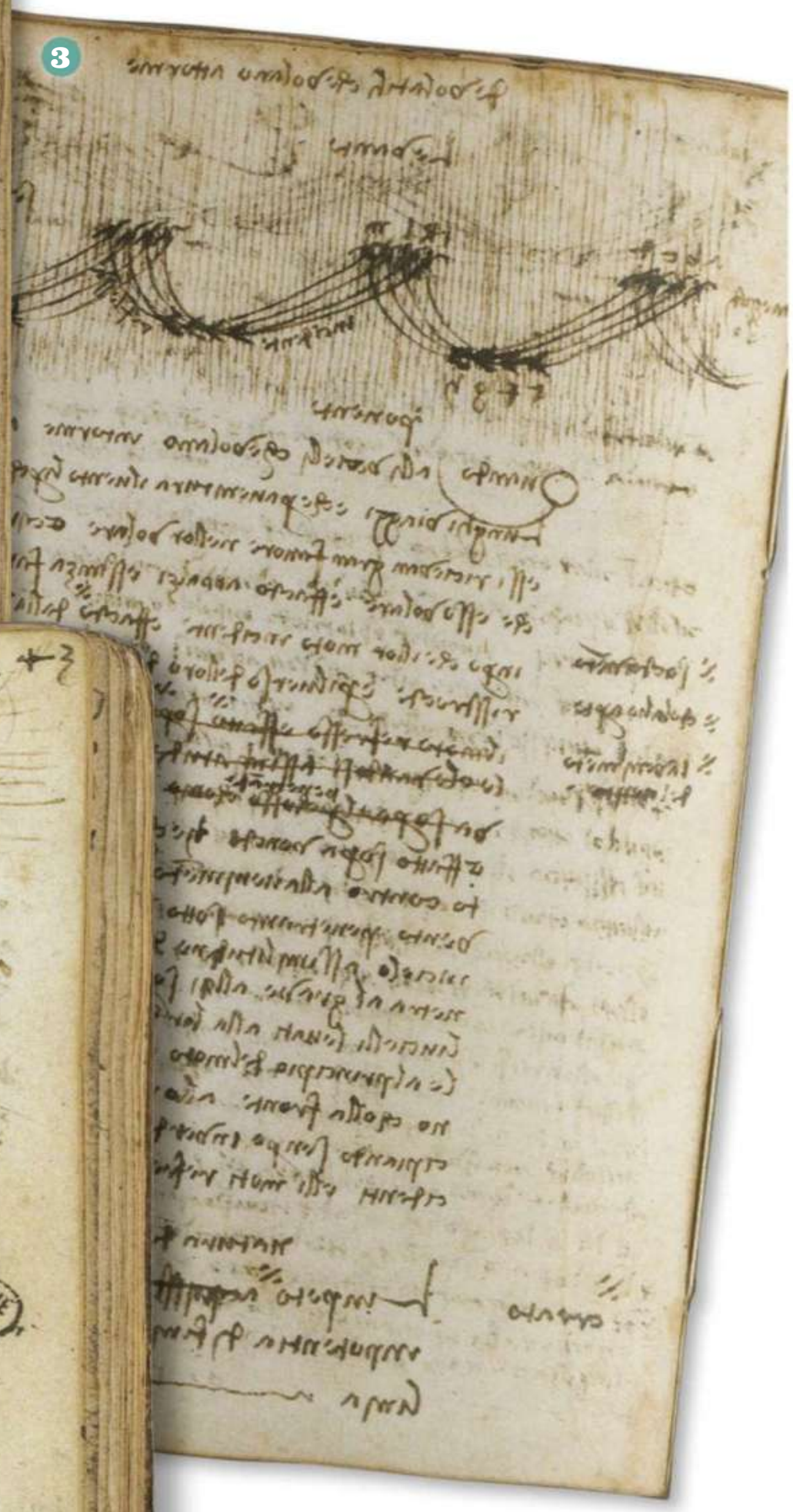

Domenico Laurenza is a Leonardo scholar and a science historian. His books include *Leonardo on Flight* (Giunti, 2004) and *Leonardo's Machines: Da Vinci's Inventions Revealed* (David & Charles, 2006)

GALLERY

Saint John the Baptist

Painted a few years before the artist's death in 1519, this rejects the traditional depiction of the saint as a gaunt ascetic. Leonardo's painting, sometimes interpreted as homoerotic, shows an androgynous youth with an enigmatic smile pointing to heaven.

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GALLERY

Lady with an Ermine

A portrait of the Duke of Milan's mistress, Cecilia Gallerani, c1490. It displays the court's interest in ideal beauty, but Leonardo also introduces psychological realism and a more dynamic pose than the traditional profile format. The ermine symbolises both chastity and lust.

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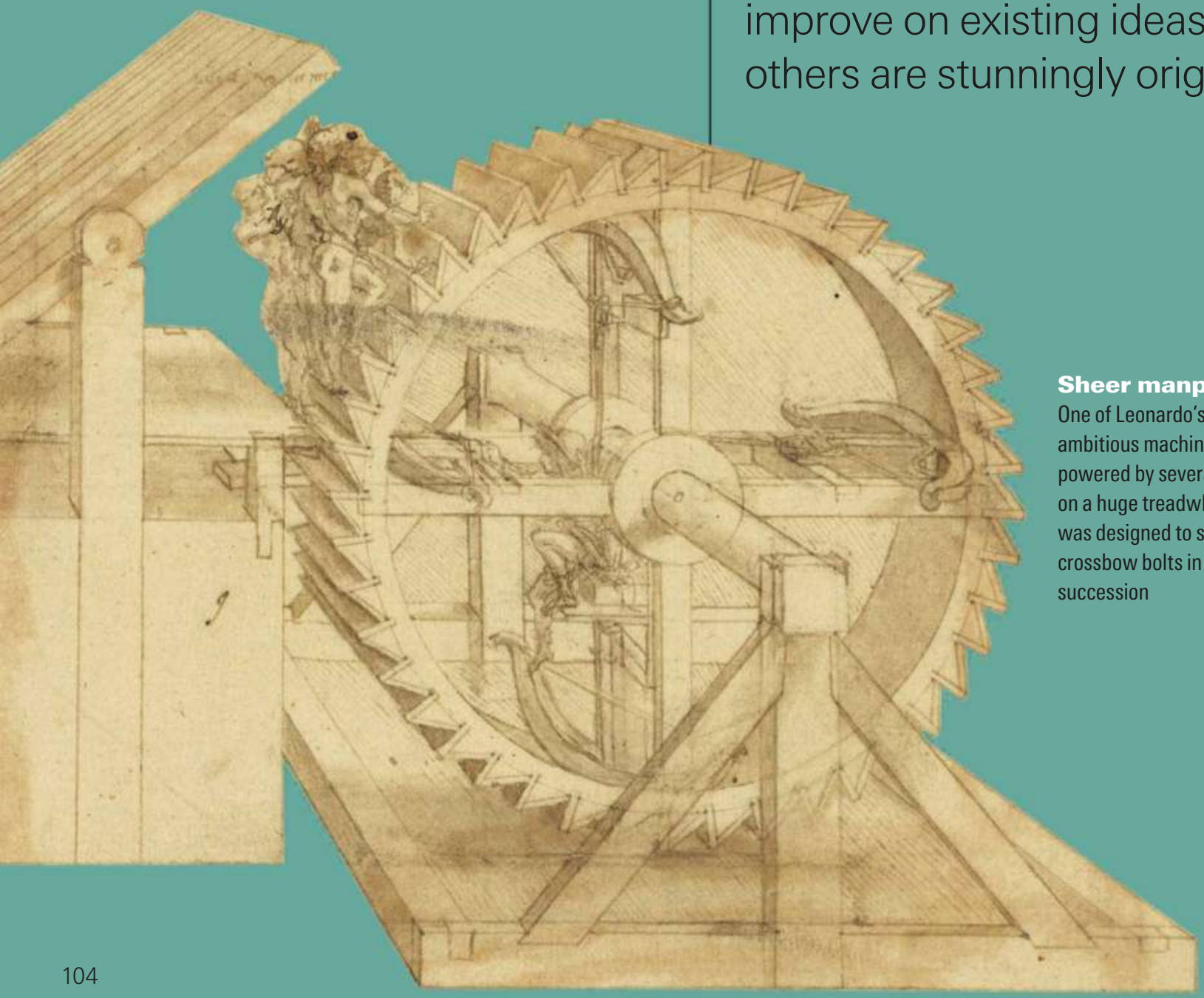
Leonardo's war machines

THE WORKS OF A MILITARY PIONEER

Matthew Landrus explores Leonardo's fascinating career as a military engineer and highlights 10 key drawings that show the extent of his genius. Some designs improve on existing ideas, while others are stunningly original



Sheer manpower
One of Leonardo's most ambitious machines – powered by several men on a huge treadwheel – was designed to shoot crossbow bolts in rapid succession

BRIDGEMAN-BIBLIOTECA AMBROSIANA-MONDADORI

The lay of the land
A map of Imola, made for military purposes when Leonardo worked as an engineer for Cesare Borgia, shows his skills as a surveyor

Despite describing warfare as *pazzia bestialissima* (bestial madness), some of Leonardo da Vinci's most extraordinary inventions are those he devised in his capacity as a military engineer. At various points during his career, Leonardo worked as a military engineering consultant for some of Europe's most powerful people: Ludovico Sforza until 1499, for the Papal Armies under Cesare Borgia in 1502, for the Republic of Florence in 1503–04, and for Pope Leo X during 1513–16.

The role was suited to a polymath such as Leonardo, who could advise on hydraulic engineering, structural engineering, ballistics, gunpowder, materials analysis, schematic design, cartography, geography, geology, bridges, flight across waterways, naval strategy and other specialised tasks. He was kept remarkably busy, often working on several ideas at once.

What survives of specific military projects is fragmentary. For example, little remains of Leonardo's preparation for a report to the Republic of Venice in 1500 on strategies for defence against Turkish invasion by land and sea. Meanwhile, among his maps and other military consulting projects for Cesare Borgia in 1502, only the famous map of Imola (pictured above), a passport and a few studies remain.

Fortunately, some plans do survive for an ambitious canal project for the Republic of Florence in 1504, in support of the state's war against Pisa. Although it was abandoned due to technical limitations of the time, the project would have diverted a portion of the Arno river away from the enemy, thus depriving their crops of an essential resource.

Evidence from the same year also shows that the Florentine authorities allowed Leonardo to work in Piombino as consultant to Lord Jacopo IV Appiani, a wartime ally, where he straightened moats and made designs for a circular fortress to be set low in the terrain, with thick walls, curved contours and sophisticated interior walkways and tunnels. The ingenious bunker was designed to deflect cannonballs and restrict access at three independent rings of the structure in the event of a siege.

At various points during his career, Leonardo worked as a military engineer for Europe's most powerful people

Seeking fortunes in Milan

However, some of the most interesting insights into Leonardo's talents as a military engineer can be found by turning to one of the earlier phases of his career, when he worked for Duke Ludovico Sforza in Milan. In fact, it was the role of military engineer that Leonardo had sought to combine with his role as visual artist for the duke. Despite having little training, the position was one of the few full-time jobs in the court and therefore an attractive prospect. Indeed, when Leonardo arrived in Milan and began work on the *Virgin of the Rocks* in 1483 (see page 48), almost 75 per cent of the duke's budget was devoted to war against Venice.

When preparing comments for his application to Ludovico, Leonardo conducted research in the Sforza libraries and asked colleagues for advice and books, while also seeking guidance from an associate in Pavia about a design for a crossbow. Furthermore, he recorded in a notebook (now compiled as *Manuscript B*)

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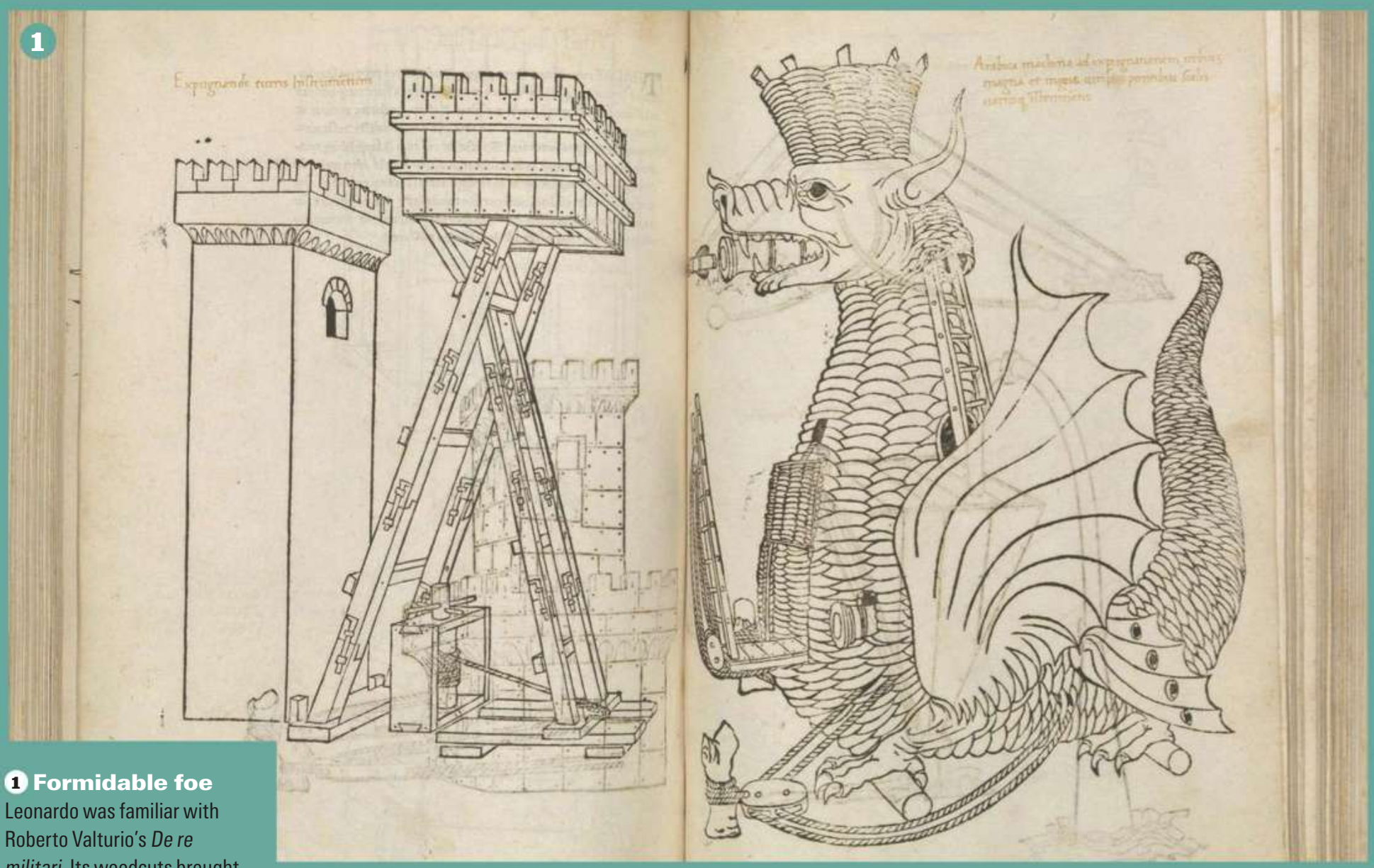
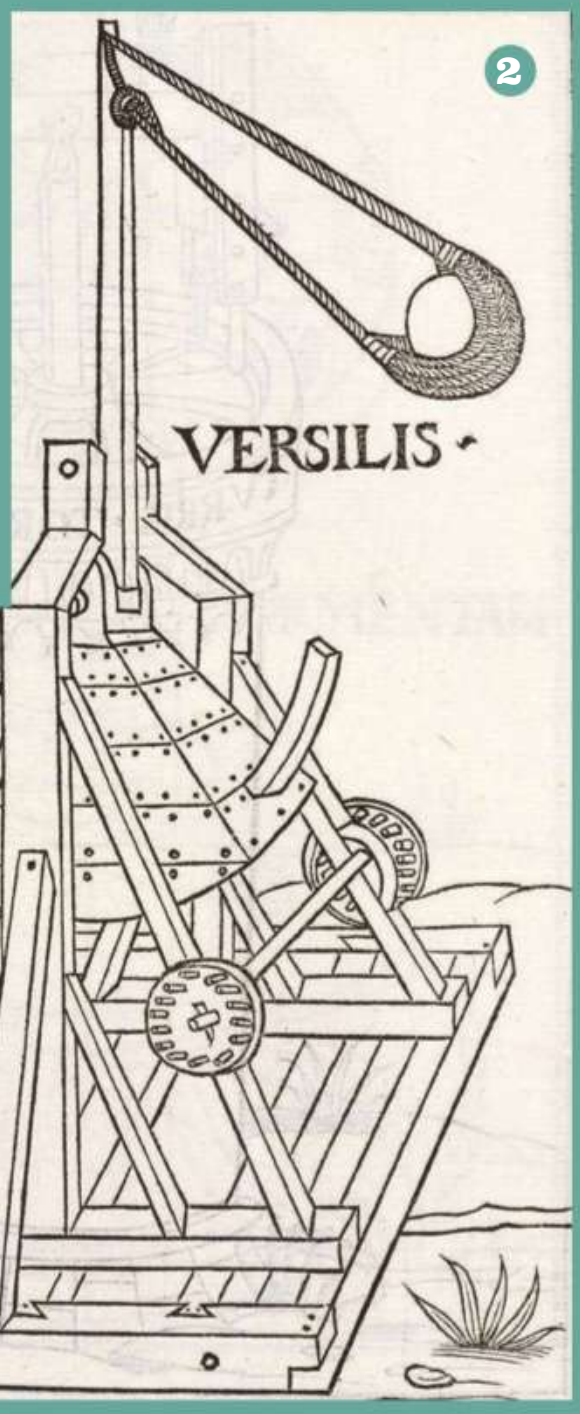
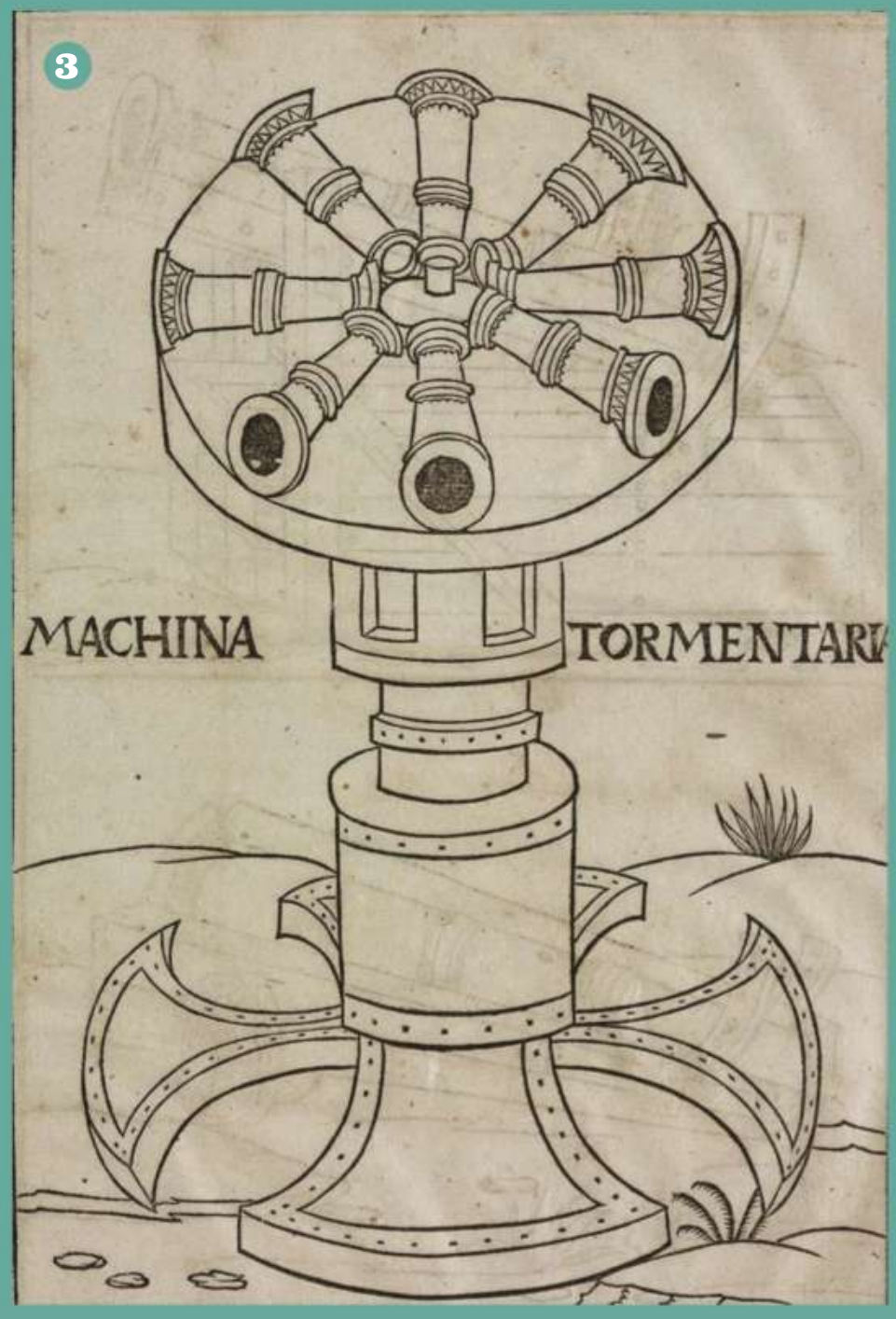


1 Formidable foe
Leonardo was familiar with Roberto Valturio's *De re militari*. Its woodcuts brought machines of war to life, such as this dragon siege tower, designed to be intimidating.



2 Heavy machinery
A trebuchet also designed by Valturio, capable of flinging heavy rocks at fortifications.



3 All-round threat
Valturio's rotating cannon table bears a resemblance to Leonardo's 'tank' and cannon boat (see page 111).

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Battle advantage
Florence's artillery breaches the walls of Pisa in 1499, as celebrated in frescoes painted by Giorgio Vasari in Florence's Palazzo Vecchio

GETTY IMAGES

that, "for the maintenance of the principal gift of nature, namely liberty, I will find the way to offend and defend while being besieged by ambitious tyrants".

Leonardo's eventual letter to the duke, written sometime between 1483–87, lists nine types of military apparatus he was prepared to design and build: various forms of portable bridges, water-raising devices, bombs, cannons, tunnels, covered vehicles, mortars, catapults and warships. To conclude the list, Leonardo briefly mentions that he would be able to pursue projects in architectural engineering, sculpture and painting, as well as undertake work on "the bronze horse".

It was this final task that was likely the main reason Ludovico wanted to employ Leonardo. In the 1480s, the duke had sought a sculptor to create an equestrian monument to his father, Francesco Sforza. But although this was a major commission (and Leonardo may have already undertaken part-time projects for the Sforza family), the polymath hoped that by placing emphasis on his military talents, he would be able to earn the security of a full-time position in the court.

Fortunately for Leonardo, the plan was a success. By 1488, he was not only at work on the horse, but had also developed a studio at the Sforza castle for his new role as court sculptor, painter, engineer, and in general, a master of visual, architectural and mechanical arts. Among the numerous requirements of this position, Ludovico asked Leonardo to write a book on painting.

Although only portions survive, it was while writing the first part of this book, around 1488–93, that Leonardo also began writing a second book, "on the science of mechanics", along with several dozen presentation drawings on military devices, potentially forming the start of a third book or treatise on the military arts. In these projects, he developed a precision system of inquiry, in terms of written and illustrated demonstrations. This kind of systematic writing, by a self-described "man without letters" (not formally educated), was unprecedented. In a short period, he was able to prove himself an essential courtier, and one of the few intellectual *omini pratici* (practical or skilled men) at court.

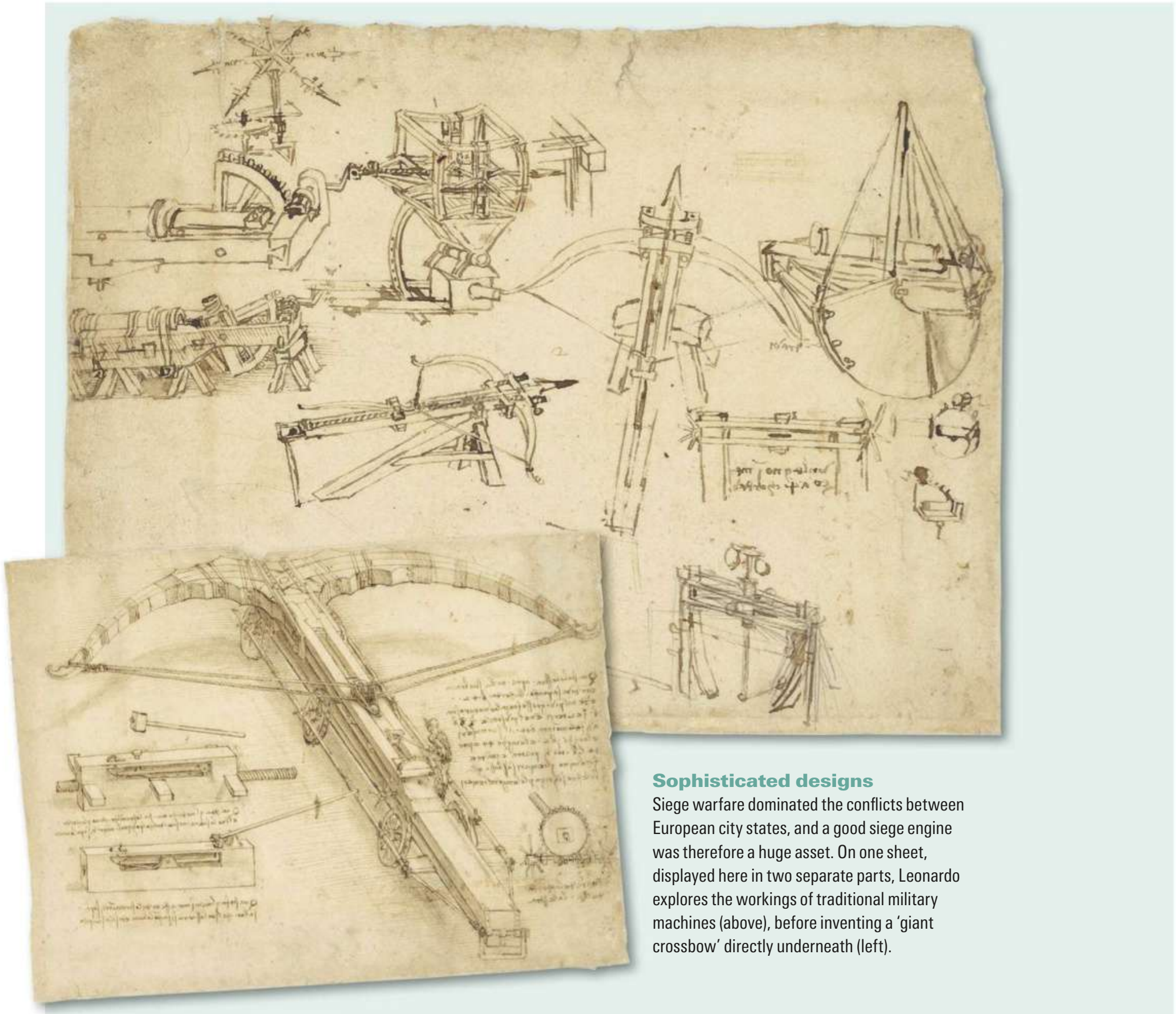
His presentation drawings on the military arts covered the essential functions he had noted in his original job application

A master of draughtsmanship

Leonardo's presentation drawings on the military arts covered the essential functions he had noted in his original job application to Ludovico: bridges, water-raising devices, bombs, cannons, tunnels, covered vehicles, mortars, catapults, warships and fortified architecture. Leonardo also copied in his notebook (now *Manuscript B*), illustrations and comments he had seen in the influential treatise *De re militari* (on the military arts) by Roberto Valturio, compiled in c1460 and printed in 1472. However, despite being inspired by Valturio's work, Leonardo made many modifications. His own devices were more sophisticated, and often intended to be much larger.

A number of these drawings are explored on the following pages. Most of the devices were never to be realised, but they reflect state-of-the-art military theory and demonstrate Leonardo's remarkable technical skills.

10 MILITARY INNOVATIONS FOUND IN LEONARDO'S DRAWINGS



Sophisticated designs

Siege warfare dominated the conflicts between European city states, and a good siege engine was therefore a huge asset. On one sheet, displayed here in two separate parts, Leonardo explores the workings of traditional military machines (above), before inventing a 'giant crossbow' directly underneath (left).

1 GIANT CROSSBOW

A massive machine designed to intimidate the enemy

The first illustration in the tenth book of Roberto Valturio's *De re militari* is his design for a fortress-mounted springald, a popular instrument of medieval siege warfare. Unlike Valturio's creation, however, Leonardo's own springald (top, centre) – included among a series of drawings examining the operation of traditional machines – demonstrates torsion springs pulling at the warped frame.

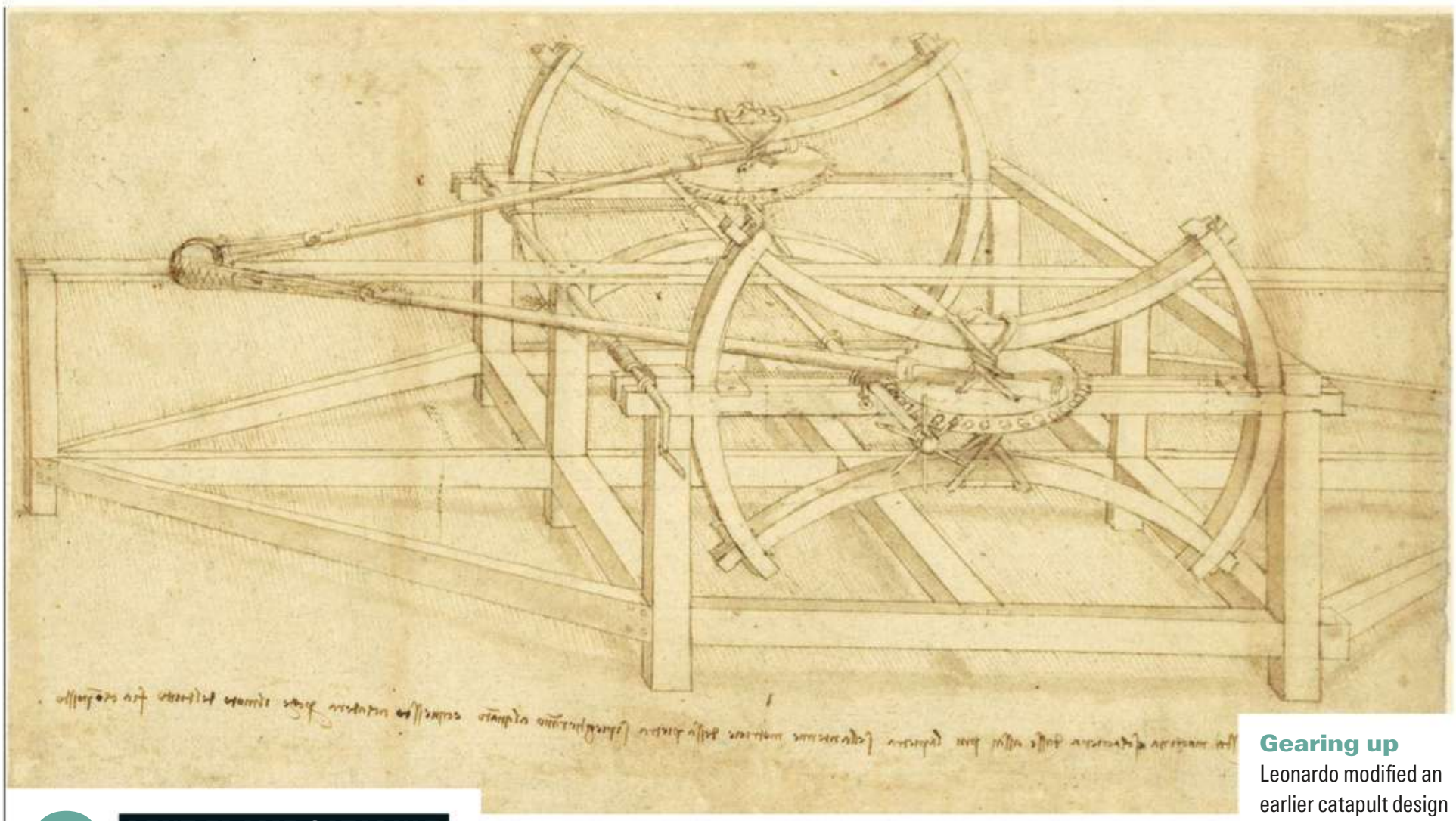
But the sheet (c1490) is also notable for the 'giant crossbow' that Leonardo depicts immediately below, which stands as the most sophisticated siege engine among his entire series of presentation drawings.

Like Valturio's dragon tower (seen on page 106), the crossbow was designed to be a terrifying threat, capable of intimidating the enemy and causing great damage.

To the right of the design, Leonardo gives measurements: "This crossbow opens at its arms, that is where the rope is attached, 42 *braccia* [arm-lengths], and is at its thickest, without its armature, 1 and 2 thirds *braccia*, and at its thinnest, 2/3rds of a *braccio* [one arm-length]. It has a draw [or elevation] of 14 *braccia*. Its carriage is 2 *braccia* wide and 40 long and it carries 100 pounds of stone; and when it is moving, the carriage lowers itself and the crossbow directs itself along the length of the carriage."

A comparison of the length and width measurements on paper with the proposed full-scale measurements of 40 by 42 arm-lengths (23.3m x 24.5m) reveals the drawing's scale of 108:1. This is not only remarkably consistent for a design of 1490, but also an excellent example of a style of drawing known as 'dimetric projection', as opposed to a traditional perspective drawing.

This, and other innovations of Leonardo's draughtsmanship, helped him to develop a strong reputation as a military engineer.



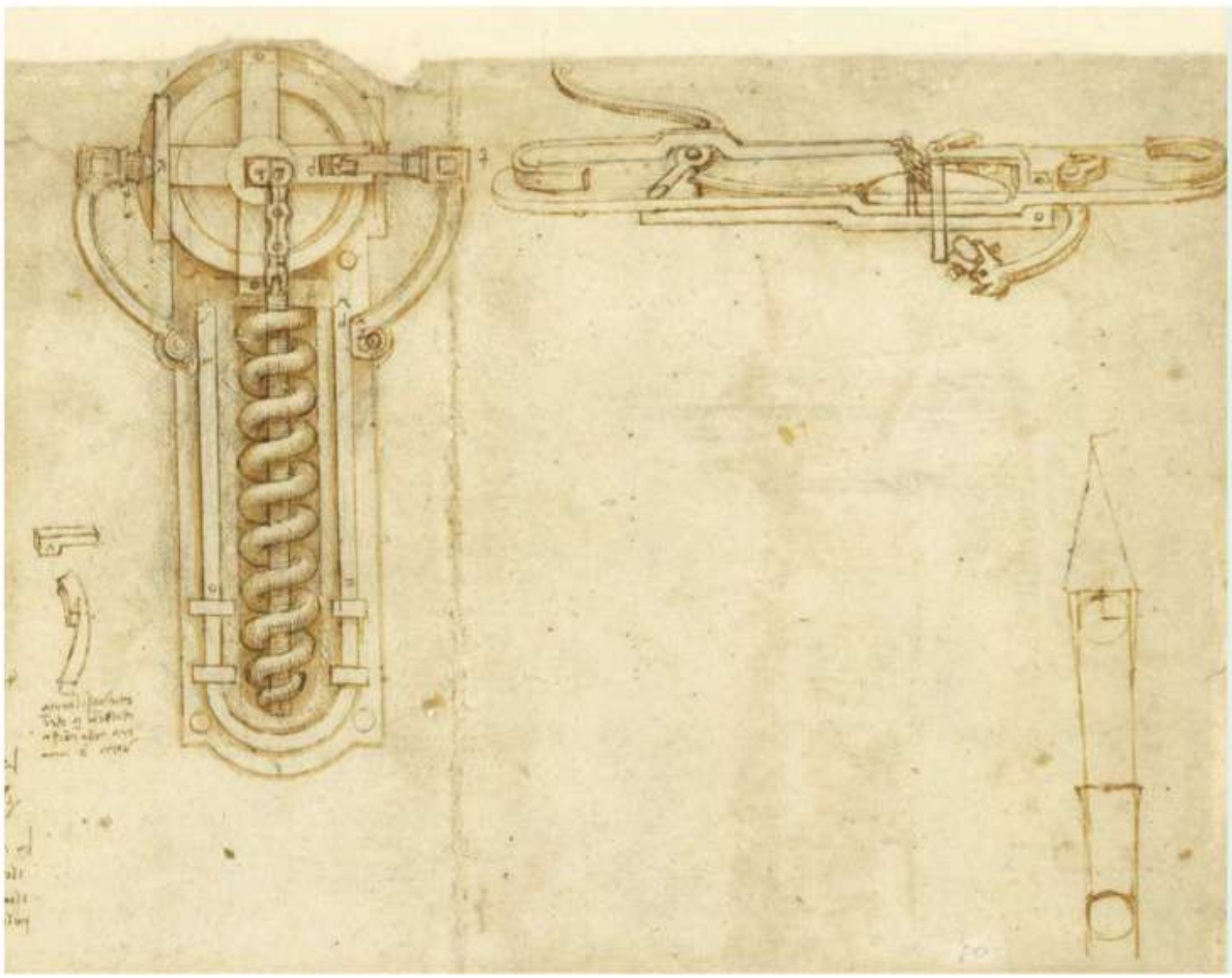
Gearing up
Leonardo modified an earlier catapult design by Valturio, adding gears to regulate movement. This resulted in a much more powerful throwing action

2 BENT-FRAME CATAPULT

A powerful device for destroying city walls

This large bent-frame torsion spring catapult (c1490) also derives from a springald design by Valturio. However, Leonardo makes a significant modification: the regulation of the turning speed of each torsion screw. By attaching gears to the torsion springs, the movement of which is regulated by a pair of wheels at each end of a bar, he guarantees that the torsion screws will apply the same amount of force to each arm of the catapult.

Overall, it is a sophisticated invention. Leonardo states at the bottom of the sheet that, "This machine projects stones with more power when the tracks holding the stones are well bent. And this is achieved by the combination of all motions".



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3 FLINTLOCK MECHANISMS

Innovative contraptions for firing weapons

The precision illustration on the left of this sheet (c1513–14) shows an unprecedented flintlock mechanism, designed for lighting cannons and firearms. To operate the spring-loaded device, Leonardo states that one should pull the pin faintly identified with an 'f', causing the steel-rimmed wheel to spin clockwise and rub against a piece of flint. The resulting friction then creates a spark, igniting the gunpowder loaded into the breech of the weapon.

To the right of the drawing, Leonardo depicts another type of flintlock mechanism, this time with a trigger handle. Again, this was possibly intended for a firearm.

Breaking a siege with cannons
This 15th-century illustration shows cannons in an assault on Genoa in 1494. They would be used to destroy walls and other fortifications

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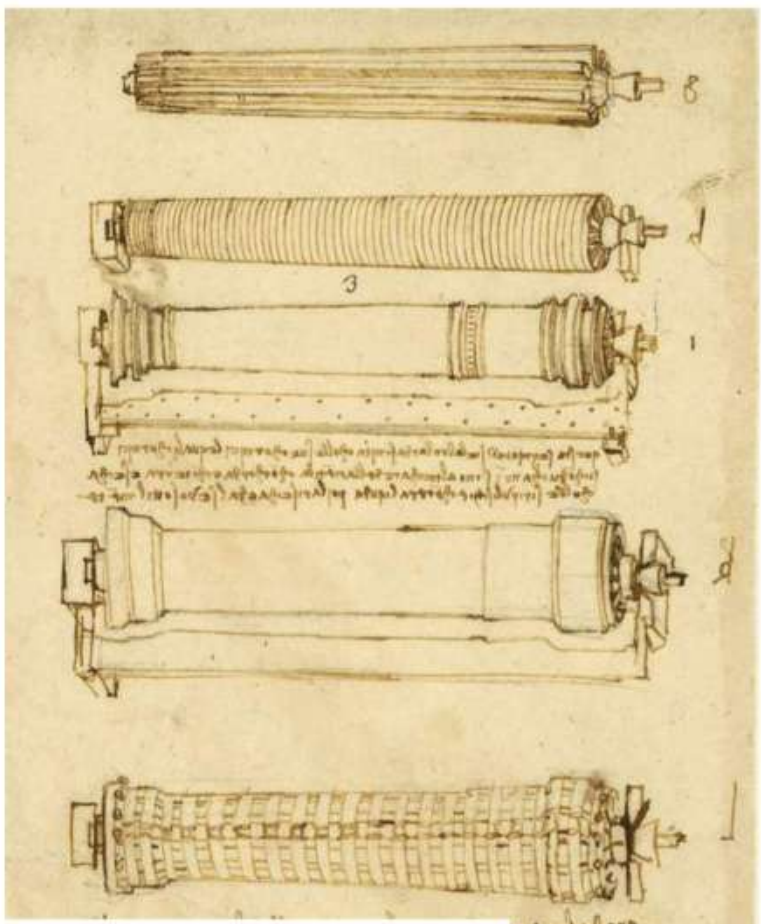


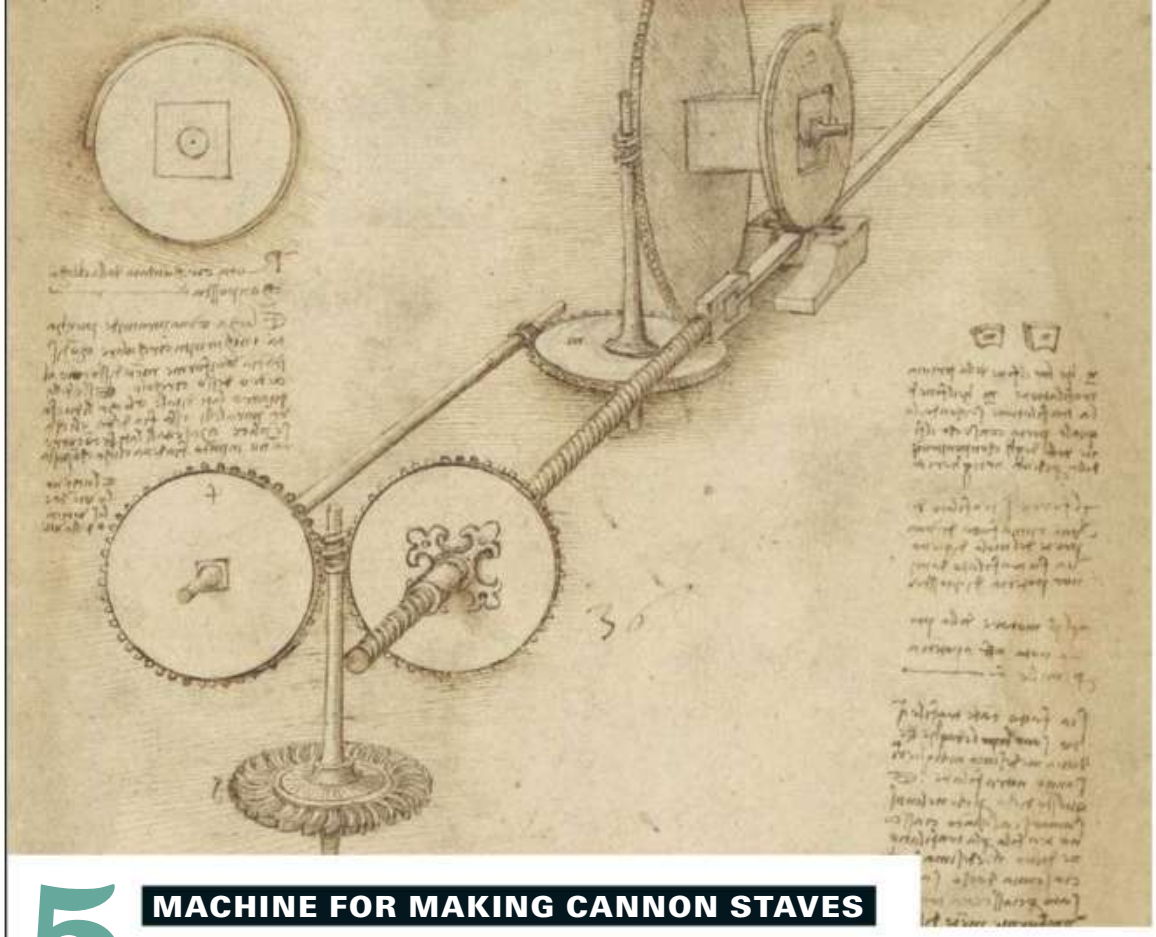
How to make a cannon
Leonardo reveals his "secrets". First used in Europe in the 1300s, the technology of gunpowder weapons was relatively new

CANNON ASSEMBLY GUIDE

4 Step-by-step instructions for building cannons

In *De re militari*, Valturio devotes a section to illustrations of 12 different types of cannon. In his own series of presentation drawings (c1490), Leonardo demonstrates – in a step-by-step process – the methods, or "secrets", for cannon manufacture. He also provides advice on materials, including grease, iron staves, and wet soil.

At the bottom of the sheet, he notes that "these iron rods must be as long as the mould, with a third of a *braccia* distance [19cm] in between each, two fingers [2.5cm] in width and one in size [1.2cm]. Take one of those iron bands used for locks and cut it lengthwise to make four-finger wide straps, wrap them around the iron rods every third *braccia* [19 cm] and throughout the length, joining the tips of the straps with wire. Add some soil on top, then place more straps in between, leaving only the top ones uncovered, and you have finished your form."



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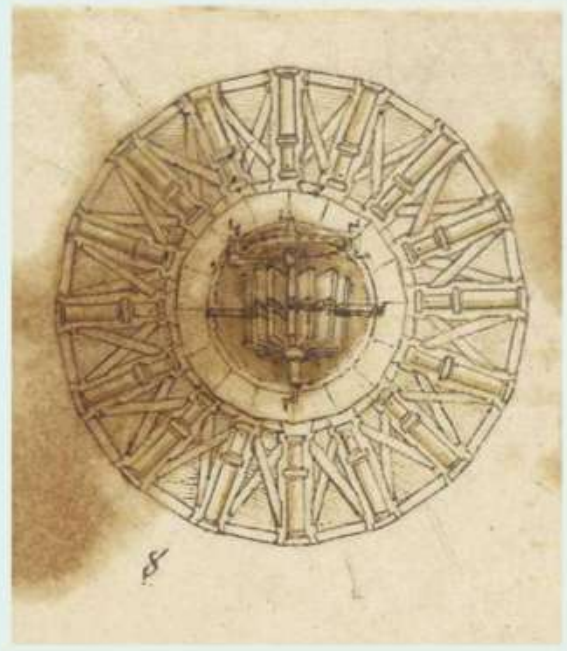
5 MACHINE FOR MAKING CANNON STAVES

A system for improving the manufacture of weapons

This drawing (c1510–15) depicts an ingenious device for shaping the long iron staves (segments) used to create the barrels of cannons. Powered by a water wheel, it features a combination of worm screws and gears, multiplying the force of the grindstone wheel over the stave. Crucially, the stave is pulled forwards as the grindstone rotates backwards.

Calculating successive multiplications of 12 (uncharacteristically from left to right), Leonardo estimates the force of each wheel, from water wheel to grindstone: "1000, 12000, 144000, 1728000, 20736000". Twelve derives from the division of 48 teeth on each forward gear by four worm screw grooves.

He states: "Without experience, one cannot speak of the true science of the potential of the resistance of iron to pressing. I have put aside these four wheels of the worm screw, each one of which has its own degree of power. These figures are real, as proven in the 13th [section] of the 22nd of my work on the Elements of Mechanics."



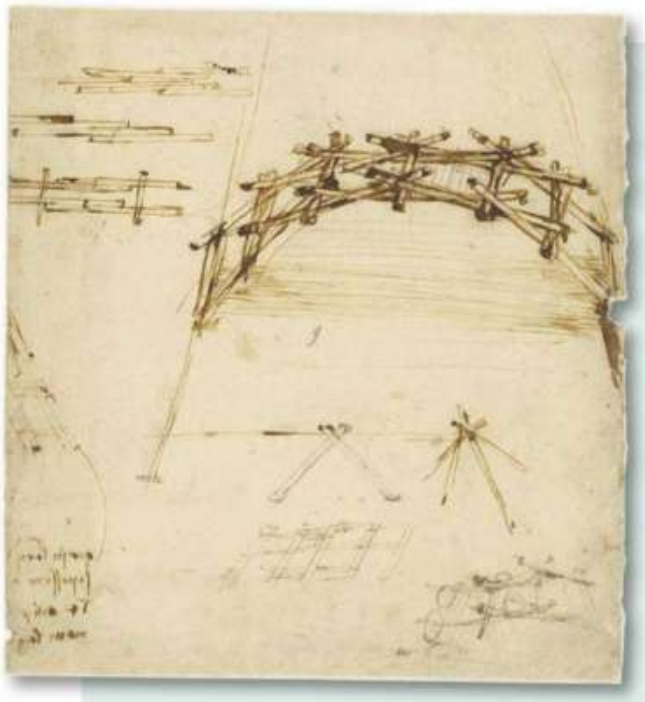
From land to water
Dating from c1500, Leonardo's boat with cannons (top) bears a resemblance to the unusual tank-like vehicle (bottom) he had previously devised around c1490

7 BOAT WITH CANNONS

A vessel with a deadly cargo

Leonardo's boat with cannons (top), dated c1500, resembles an earlier drawing he made of a 'tank' (bottom), as well as Valturio's rotating table with cannons positioned around the edge (shown on page 106). As in the case of the tank, two men would be required to propel the boat forwards using hand cranks at the centre, while the cannons would be muzzle-loaded (through the front of the barrel) – possibly by retracting them into the craft.

The purpose of the faint lines extending from some sides of the hexadecagon is not known, although it has been proposed that these could be oars for turning the boat each time a cannon is fired, thereby getting the next one into position.



6 PORTABLE BRIDGE

A structure for putting an army in position

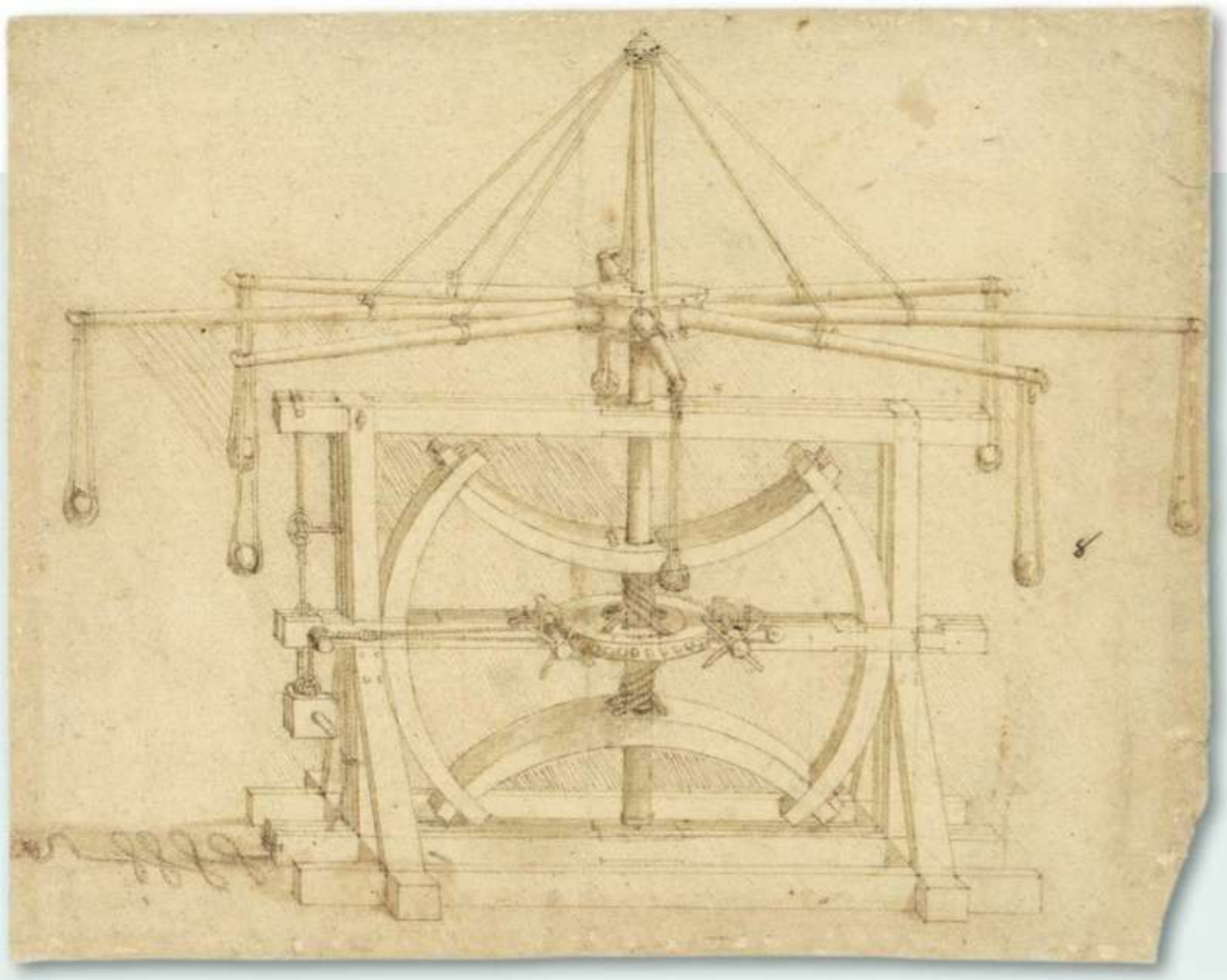
Logistics was often the most important strategy during war, which may be why Leonardo started his application to Ludovico Sforza with two points about building an "infinite number" of portable bridges. Moreover, in *De re militari*, Valturio devotes his largest section of illustrations to methods for crossing moats and scaling walls.

The arched bridge shown here (c1485–87) is remarkably simple and structurally sound, requiring at this point only a walkway to cover it. As Leonardo states on a neighbouring sheet: "these wooden shafts must be as thin as spears, so that they can be easily raised from the water surface to a level where you can build the bridge on four or five points. You then position large beams in place of the spears and make up a structure of two by two arms," or rather, a pair of beams that are interlocked.

8 MULTIPLE SLING

A weapon that would be dangerous for all concerned

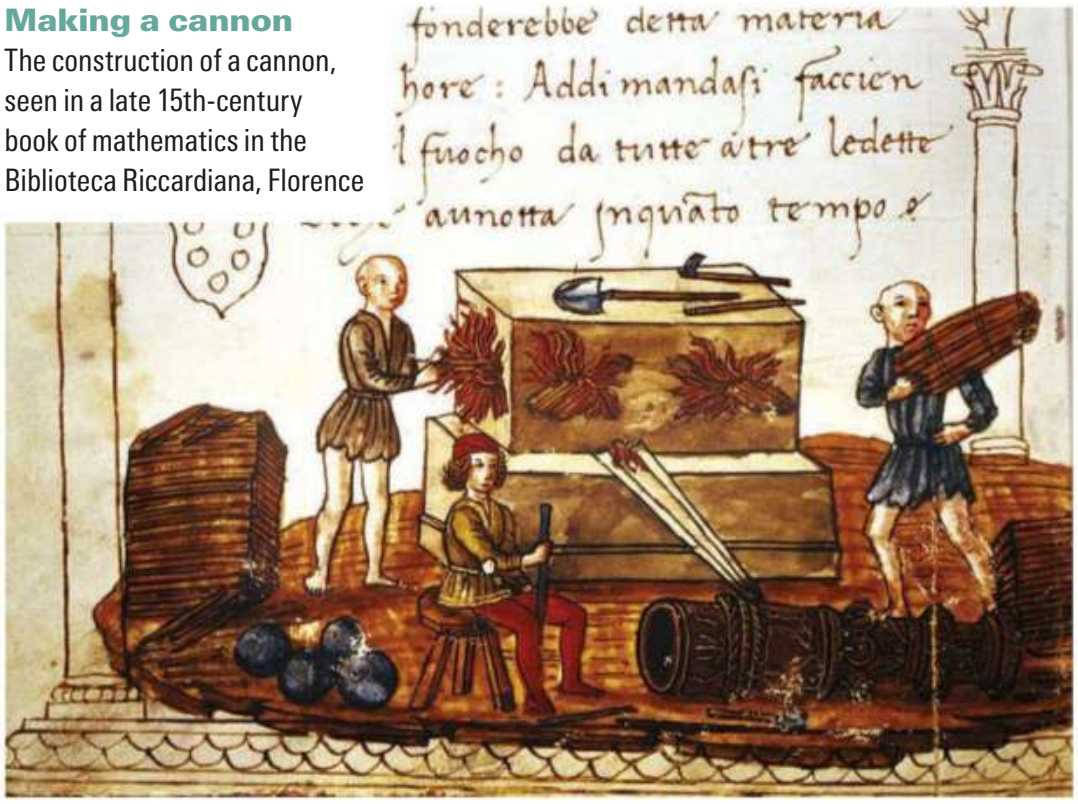
This drawing (c1490) depicts an ambitious invention designed to measure at least 3.12 metres between the tips of the horizontal poles at the top. In theory, the loops of rope visible at the base would allow one to trigger the device from a safe distance. But as with other catapults by Leonardo, it would still be dangerous for operators due to the large bent beams – not to mention the rotating slings.



BRIDGEMAN-BIBLIOTECA AMBROSIANA-MONDADORI/BRIDGEMAN

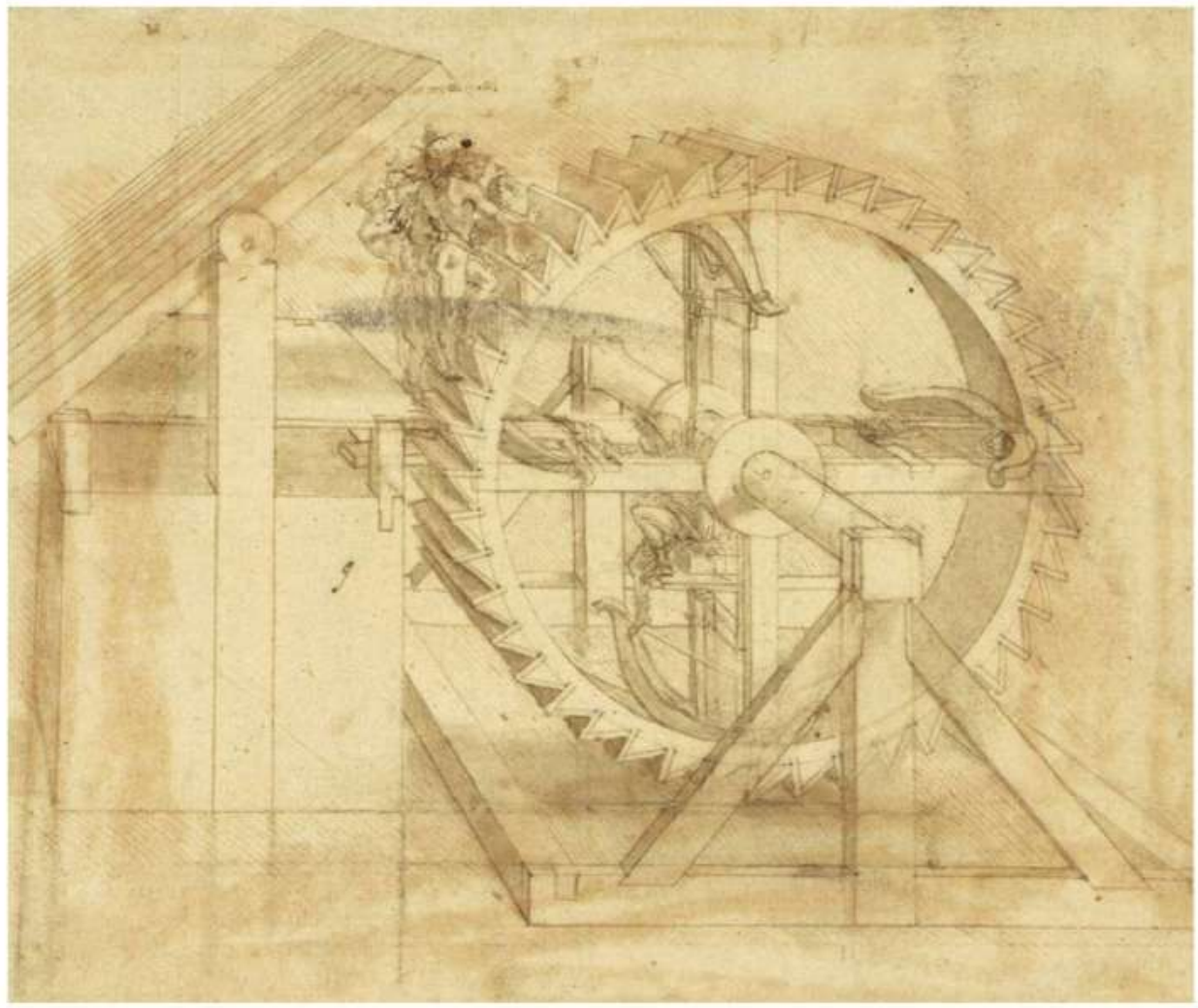
Making a cannon

The construction of a cannon, seen in a late 15th-century book of mathematics in the Biblioteca Riccardiana, Florence



9 REPEATING CROSSBOW

A devastating machine reliant on team effort



BRIDGEMAN-BIBLIOTECA AMBROSIANA-MONDADORI

At the top of this giant repeating crossbow drawing (c1490), Leonardo notes "10 men at 2,000 pounds". Thus, ten men each weighing 200 pounds would rotate the stepped wheel into place so that a crossbowman stationed inside the 6.5-metre diameter wheel could position the trigger and shoot a bolt.

In a separate preparatory drawing, Leonardo writes that 20 men weighing a total of 4,000 pounds would add enough weight to span (draw back the ropes of) the four crossbows. He indicates that with each of their 30 steps, the accumulated tension on the crossbow ropes could be 120,000 pounds (4,000 x 30, in his opinion). Although he illustrates 46 steps, rather than 30, the point of the demonstration is that the engine could quickly span and shoot large darts long distances.

Destructive power
Early cannons simply fired a ball of stone or metal. Leonardo filled shells with gunpowder or incendiary material that broke open or exploded upon impact

10 EXPLOSIVES

A mortar for firing highly explosive shells

This drawing (dated c1490), shows two mortars, one of which fires a type of fragmentation bomb.

As well as studying with bomb experts such as Francesco di Giorgio Martini, Leonardo was inspired by Valturio's earlier treatise, which mentions several kinds of *flammea* or *astula* – incendiary devices made from balls of Ethiopian wool thread and soaked in "willow coal, saltpeter, aqua vita, sulfur, incense, and pitch with camphor", and sometimes "liquid varnish, petroleum oil, turpentine, and strong vinegar". In their writings, both Valturio and Leonardo refer to these weapons as "Greek fire", hurled at ships with the help of slings.

Possibly influential on mortar designs between the 18th and 20th centuries, this is one of Leonardo's most important military inventions. H

Matthew Landrus is a research fellow at the University of Oxford. He has published several books and dozens of essays on Leonardo, including *Leonardo da Vinci's Giant Crossbow* (Springer, 2010)

COMMENT
MARTIN KEMP ON LEONARDO'S LEGACY

"Without him, the history of art would have looked very different"

Leonardo da Vinci died 500 years ago. He completed notably few paintings – no more than 20, by my count. He pursued many ephemeral activities, not least the devising of stage machinery for festivals, but published almost nothing on the many sciences and technologies about which he wrote in semi-legible mirror script. Why, then, does he matter today?

The pragmatic answer is that Leonardo's legacy continues to exercise a fascination on a universal basis. He painted what is the world's most famous picture. But being famous for being famous is not enough, even in this age of celebrity. There must be something more essential and enduring to which we can point.

If we want an art-historical answer, we can say that he radically reformed every genre of painting that he touched. He changed the way that pictures were designed, using 'brainstorm' sketching techniques of unprecedented dynamism. He depicted narratives with an unrivalled command of gesture and expression. He reshaped 'Madonna and Child' compositions into little narratives, foretelling the Passion.

His portraits of women communicate with viewers outside the picture, not least us, in a very daring way. We might add that he was a great innovator in architectural design, even if he was not the architect of any known building. Without him, the history of art would have looked very different.

This seems to be enough for one person, but he was many things in addition to an artist. If we want to gain a sense of the legendary *uomo universale* (universal man), we can point to the way engineers, anatomists, biologists, geologists, physicists and some mathematicians are keen to salute Leonardo as their ancestor. If we set out today to compile the equivalent of a 'Leonardo' from practitioners of modern professions, we would need at least a dozen, maybe more. It is clear that he was more diverse in his activities than anyone before or since. In each of the fields he explored, he used drawing as a tool for research, understanding and demonstration in ways that reformed how information might be gleaned and communicated. His anatomical drawings and exploration of the long history of the "body of the earth" were unsurpassed in his era, even if they were little known. No contemporary showed a comparable awareness of the complexities of optics, including the workings of human perception. His mechanical inventiveness knew no bounds.

But I think we are still missing the central point, which involves unity rather than diversity. Leonardo saw everything in the physical universe created by God as integrally related. Crucially, the human body was a microcosm or 'lesser world', in which everything we see outside us is mirrored within us, in terms of how the laws of nature are expressed in the forms and mechanisms of the created world.

To take just one important example, relevant to so many of his paintings: the curling of hair resembles the turbulence of flowing water. Hair and water both tend to curve in a circular manner, and the resulting configurations are helices. Leonardo was able to express such commonalities with so much graphic and painterly vitality that we seem to be witnessing the inner and outer life of nature itself.

All the paintings definitely attributed to him have a strange, living presence that renders them uncanny and even uncomfortable. Leonardo saw himself as remaking nature in a godlike manner. But his images are more than reconstructions of nature using his knowledge of causes and effects: they imply and evoke a world that lies beyond appearance. This is particularly the case after 1500. He achieves this transcendent quality through what I call the 'optics of uncertainty' – the withdrawal of the absolute certainty of seeing, in which the forms, particularly their boundaries, are elusive.

Whether the subject is a beloved lady or the Saviour, Leonardo invites us to infer that there is more to his work than perhaps meets the eye. His *Mona Lisa* (see page 59) and *Salvator Mundi* (see page 91) both deny access to their secrets in ways that relate closely to Renaissance poetry and theology. Leonardo was the suggestive master of the ineffable that lies beyond the scope of our finite senses.

At the centre of the cerebral system, as he envisaged it, were the faculties of *intelletto* and *fantasia* (intellect and imagination). They acted in perfect concert. The result was a conjoined vision of science and art. No one had done this as majestically before, or has since. H

Martin Kemp is emeritus professor of history of art at the University of Oxford. This text is adapted from his most recent book, *Leonardo by Leonardo* (Callaway Arts & Entertainment, 2019)

All about the curl
Detail from *Studies for the Head of Leda*, which can be viewed in full on page 73. Leonardo saw parallels between the curling of hair and the flow of water

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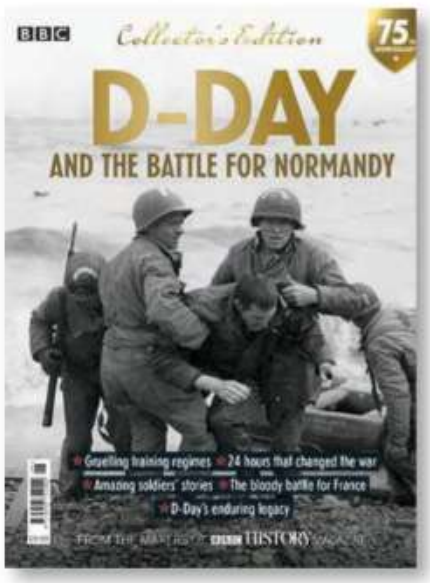

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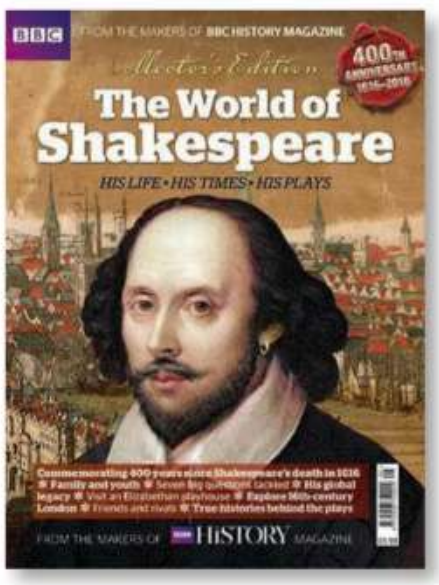

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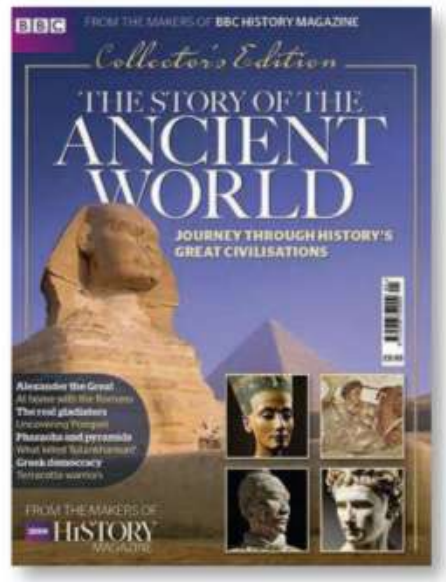

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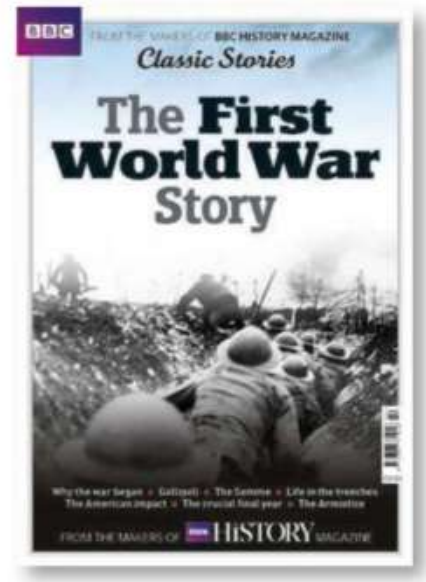

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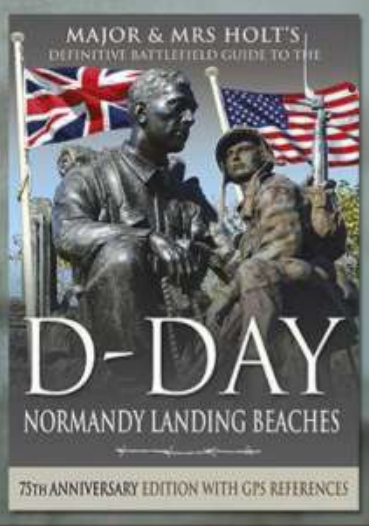

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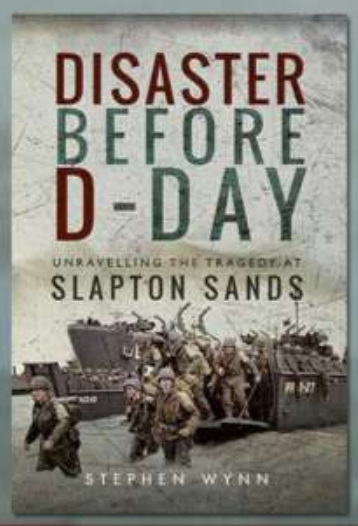

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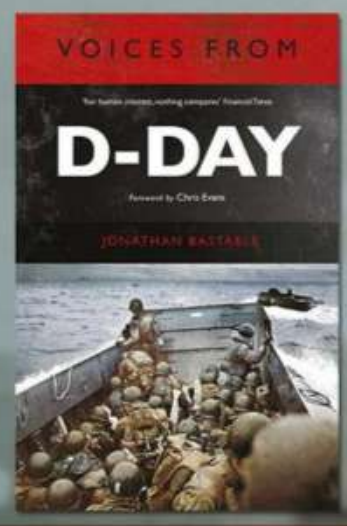

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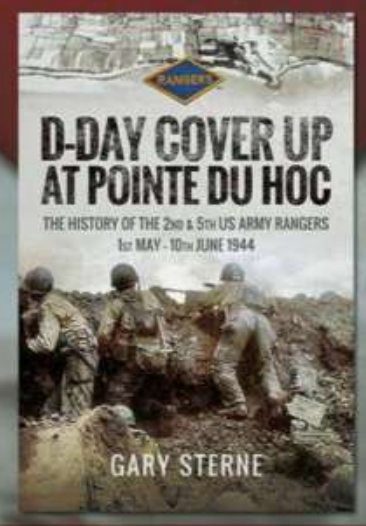

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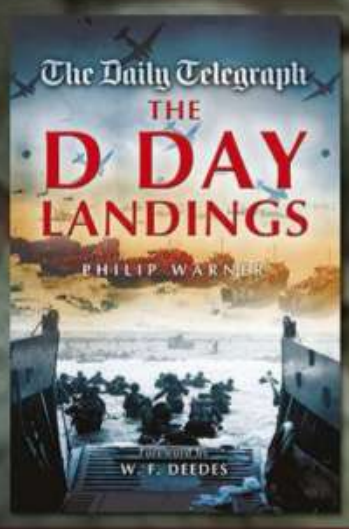

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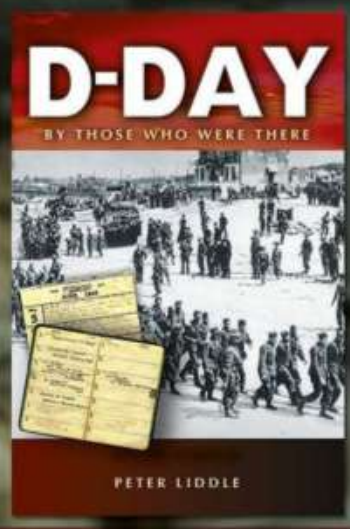

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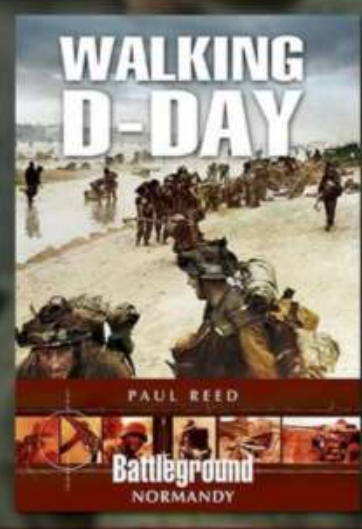

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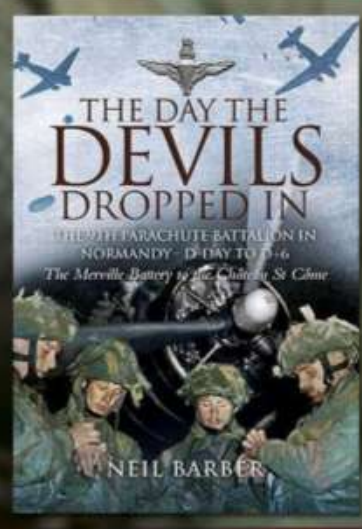

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